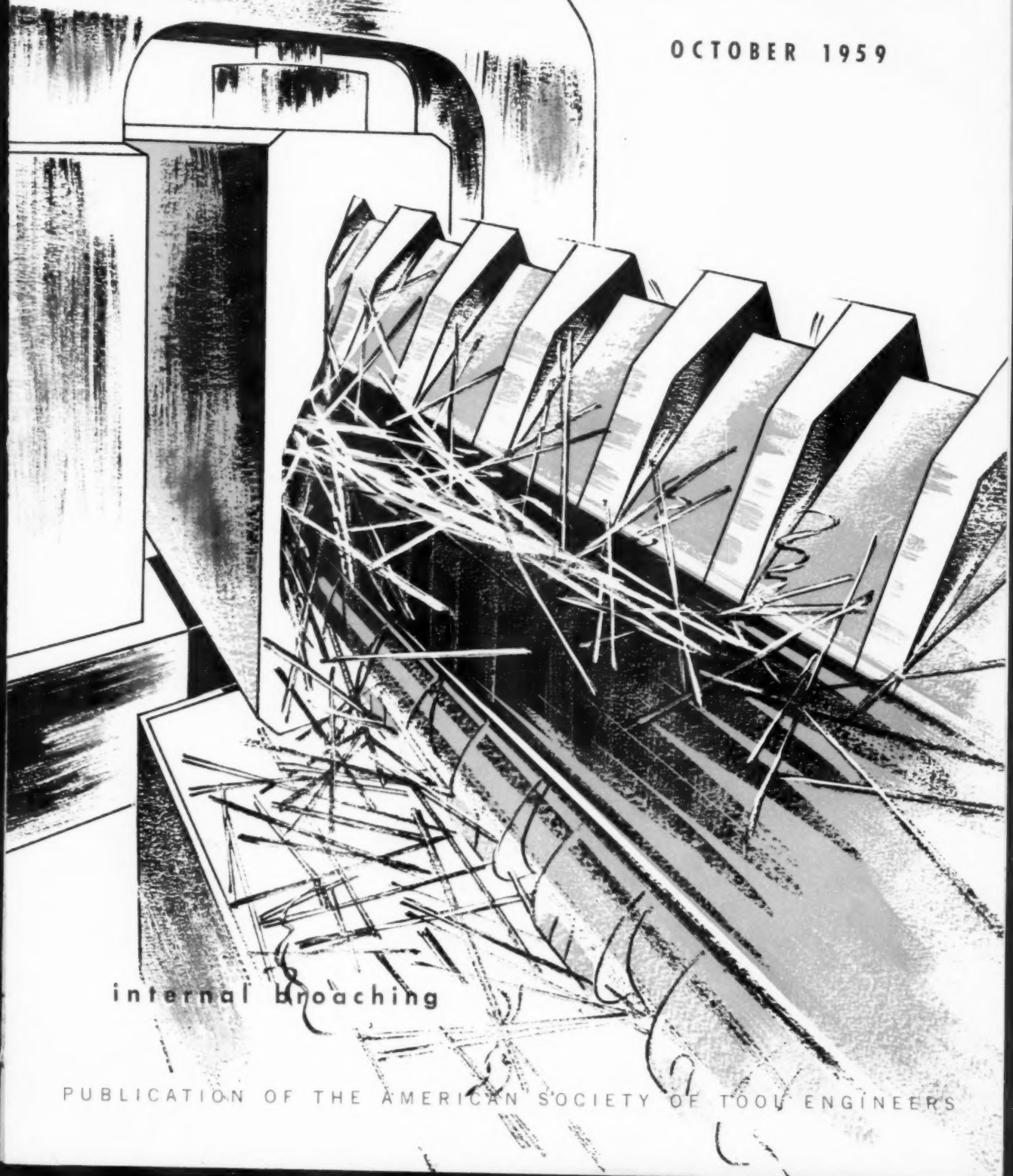
the TOOL ENGINEER

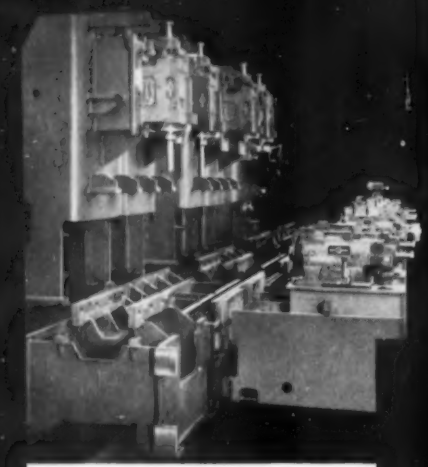
OCTOBER 1959



internal broaching

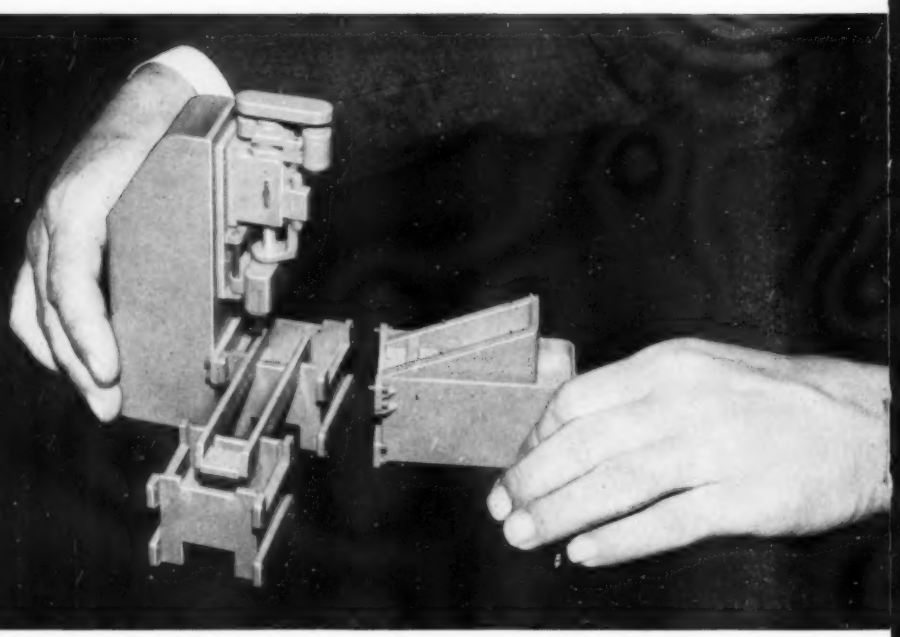
PUBLICATION OF THE AMERICAN SOCIETY OF TOOL ENGINEERS

BUILDING-BLOCK AUTOMATION...



This 15-station Model S Bore-Matic, in process of assembly at Heald, shows the application of standard base and wing components for vertical and horizontal mounting of 20 Heald BORIZERS. Machine will perform 174 drilling, spot drilling, tapping, spot facing, core drilling, reaming and gun drilling operations on automotive transmission valve bodies.

Scale model of standard building-block units for automated Borizing equipment, showing two center sections, a vertical column with BORIZER in position and a horizontal wing base with angular column for BORIZER mounting.



It's **HERE**, at HEALD, right now!

WHETHER you call it "modular construction" or "building-block design," it's already an accomplished fact at Heald.

Recognizing that standardization of components for automated Borizing equipment can effect *substantial savings* in initial cost and job changeovers, Heald has designed and built standard center sections, wing bases, angular raising blocks, vertical columns and slide units which can be integrated to perform virtually any combination of roughing, semi-finishing and finishing operations. The Heald system of basic components is fully compatible with the proposed new INDUSTRY STANDARDS, which mark a major advance in the application of automated production equipment.

These standard components are ideally suited to the use of Heald BORIZERS, tooled to the requirements of any job. Changeovers are simply a matter of replacing or adding basic units, modifying workholding equipment if required, and retooling the BORIZERS. Completely self-contained Heald Red Head BORIZERS, providing flexible control of feeds and speeds, simplify retooling and recycling, permitting the most versatile building-block arrangement obtainable.

Ask your Heald engineer to schedule a scale-model demonstration of the new modular design.

It PAYS to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.
Worcester 6, Massachusetts

Chicago . Cleveland . Dayton . Detroit . Indianapolis . Syracuse . New York

HEALD

the tool engineer

Vol. 43, No. 4

October 1959

Creative Manufacturing IS TOOL ENGINEERING

Surface Specifications: Their Use and Meaning ..... *By Charles H. Good* 77
When surface finishes are correctly specified, design requirements can be successfully achieved in production.

Gadgets 81
Spring speeds saddle milling setup . . . . "equalizing" milling fixture . . . . dovetail adapter for automatic lathes . . . . retractable punch.

Parts Straightening: How To Improve Efficiency ..... *By R. L. Jones* 85
Time spent in studying and improving hand straightening operations pays off in greater productivity and accuracy.

Building-Block Machine Broaches Long Holes ..... *By T. W. Black* 89
Conveyorized tooling and a traveling platform for the machine operator result in exceptionally high output with an "elephant" broach.

Cast-to-Shape Workholders Simplify Tooling Problems ..... *By Richard Spoor* 97
Because of their irregular shape, many forgings and castings cannot be held in standard chuck jaws. Cast workholders are a solution.

Eliminating Chatter in Machine Tools ..... *By M. Sadowy* 99
Chatter problems should be eliminated during machine structure design. A successful design approach is described.

Diamond-Wheel Grinding of Tool Steels ..... *By L. P. Tarasov* 109
Hard tool and die steels can be quickly and economically ground with diamond wheels. Man-made diamonds give best results.

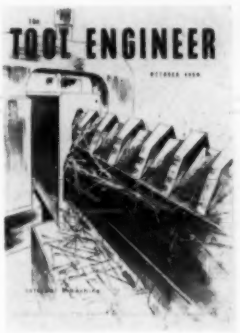
Practical Plastics Tooling Ideas ..... *By Alan M. Fullarton* 118
The ease with which plastics are fabricated contributes to cost savings for many different types of tools.

Corrected Form Tool Angles (Reference Sheet) ..... *By Robert M. Dickson* 123
When form tools are used for combination forming and facing operations, tool faces are ground at special angles.

ASTE NEWS FEATURES 125

President's Editorial 75
Designed for Production 92
Field Notes 175
Good Reading 183
Letter from the Editor 3
Looking Ahead (Newsletter) 264
Men at Work 187
Progress in Production 145
Readers' Viewpoints 170
Tech Digests 195
Technical Shorts 185
Tool Engineering in Europe 191
Tools at Work 104
Tools of Today (New Products) 149
Trade Literature 179
Who's Meeting and Where 189

THIS MONTH'S COVER



Broaching is the only feasible method for finishing exceptionally long holes. Here a massive pull broach is emerging from the interior of a 24-foot-long helicopter spar. After broaching, the exterior of the workpiece is milled to shape. Full details on the broaching operation are contained in the article starting on page 89.

THE TOOL ENGINEER is regularly indexed in the *Engineering Index Service* and *Applied Science & Technology Index.*

STOP LOOK Compare

This new mammoth SUPER TAILSTOCK now furnished on "AMERICAN" De Luxe Model 32" Style "I" and 40" Style "J" Lathes has . . .

- 7½" Diameter Spindle—Long Travel
- Unparalleled Rigidity
- Circular Depth Dial—Easily Read
- Built in Single and Two-Speed Types
- Convenient Front Controls
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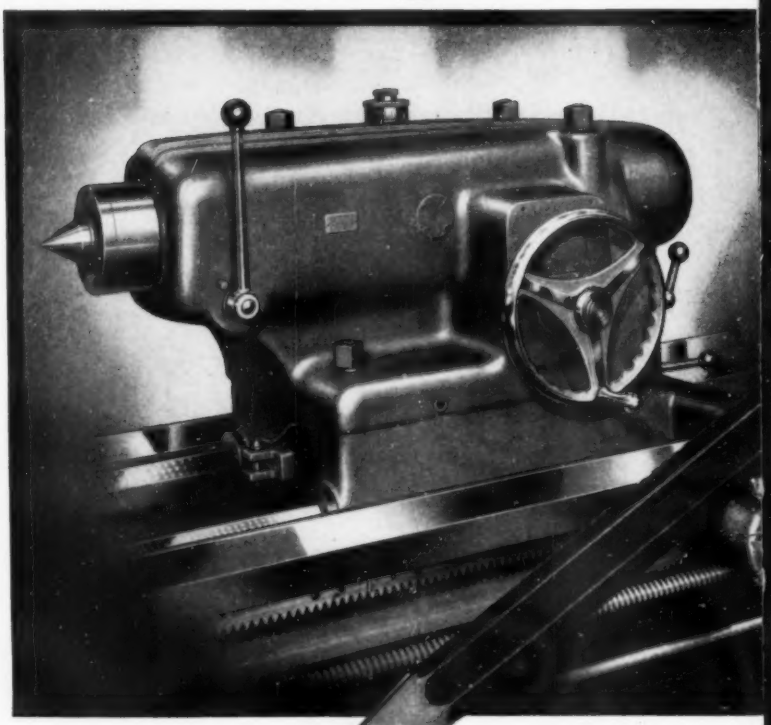
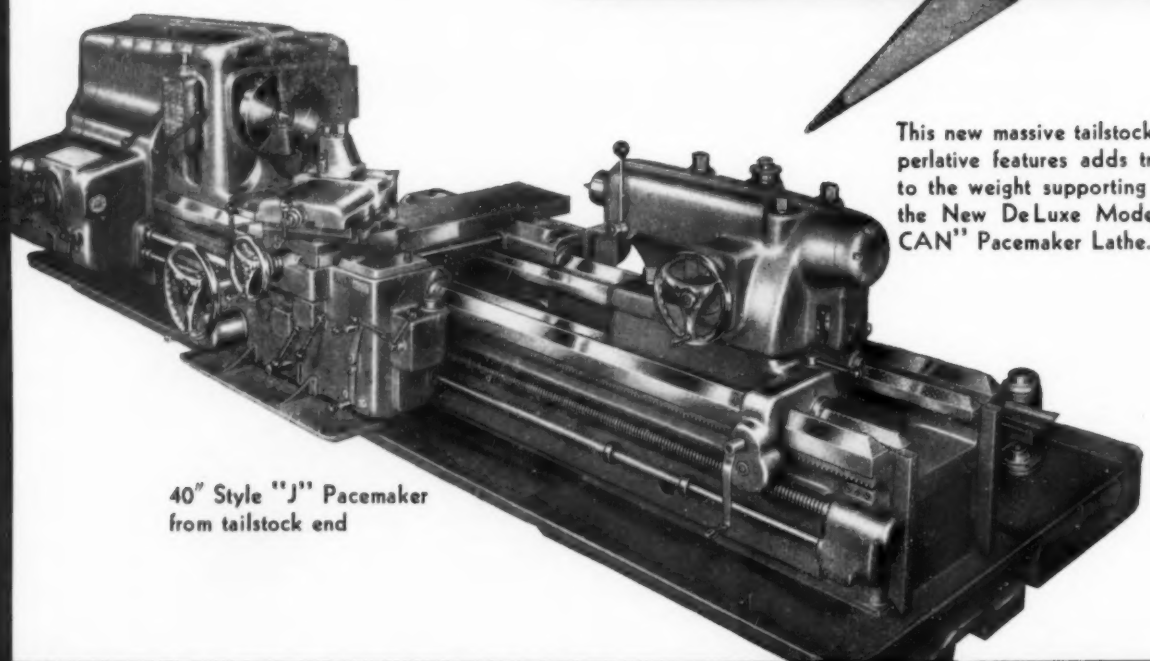
Send for Bulletin No. 144 for complete details.



This new massive tailstock with its superlative features adds tremendously to the weight supporting capacity of the New De Luxe Model "AMERICAN" Pacemaker Lathe.



40" Style "J" Pacemaker from tailstock end

THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

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Burn It Up!

In their enthusiasm about the many advantages in high-speed machining, many propose increasing the speed of machining until the tool literally burns up. They reason that cutting tools are cheap and that machine tools as well as labor are expensive. Anything that increases production should be economic.

True, many cutting tool materials have good strength and resistance to abrasion at the elevated temperatures associated with high-speed machining. Also, under proper conditions, increased accuracy and finer finish are attributable to faster speeds in cutting. The most economic cost of machining, however, is always made up of several factors that may be either calculated or determined from shop tests. These include costs for tooling, resharpening, machining, tool changing, loading and unloading. Each, with the exception of loading and unloading, is related to the cutting speed.

Plotting cost data relative to cutting speed and combining the curves quickly shows the most economic speed at the point of inflection in the curve. Only at extreme cases of low cost for tooling, sharpening and setting could burning up the tool be justified.

All this presupposes that the machine has sufficient rigidity and horsepower, that the spindle is capable of the speeds required, that the chucking method is adequate, and that the workpiece is of such shape and size to preclude problems of distortion. Economics continue to affect the decision regarding the proper method of machining.

Often, with all other factors pointing toward higher speeds of machining, the cost of workholding may be prohibitive for the quantity of workpieces required. Any savings through higher speeds would be more than offset by the cost of fixtures.

There is nothing new in this approach to a machining problem. It does illustrate, however, that enthusiasm for a method may be responsible for overlooking well-known factors. Whether the process under consideration involves machining, explosive forming, or electrolytic grinding, there is no substitute for an engineering analysis. This the tool engineer does every day.

John W Greve

EDITOR

Buy your drills with the same care you used in buying the machine tool to run them.

STARTING POINT FOR HIGHER PRODUCTION

Today's production quotas demand that your machine tools deliver with all the speed and precision built into them. Equip your drilling machines with the drills that will permit them to operate with maximum efficiency and economy . . . COGSDILL . . . *the name to remember for quality . . . to watch for progress.*

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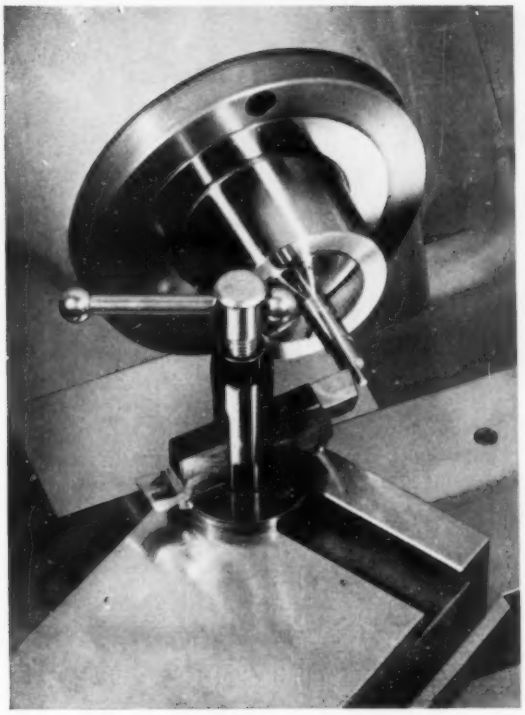

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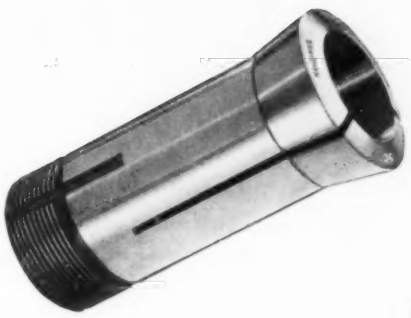
HARDINGE



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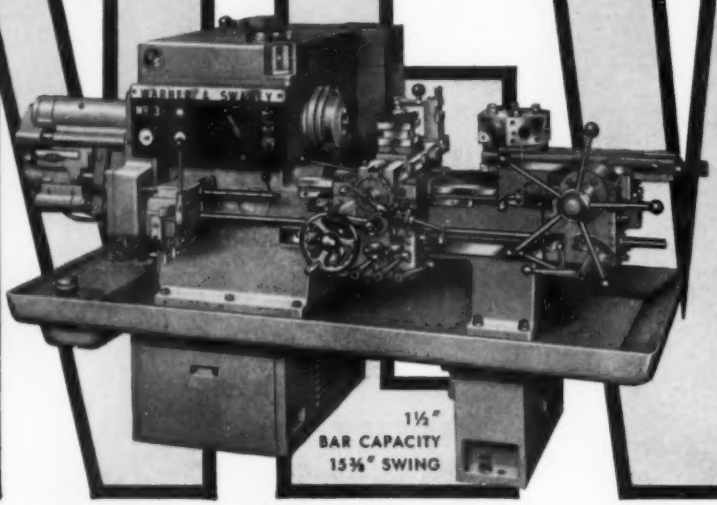
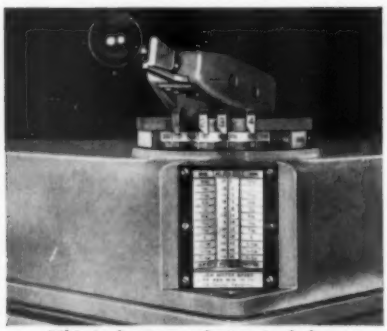
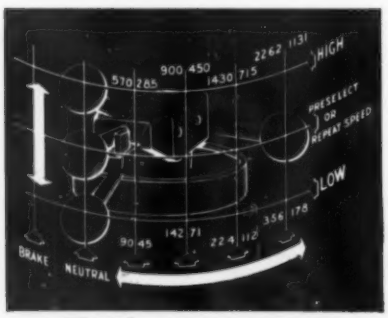


WARNER & SWASEY No. 3 ram type turret lathe



This is the new exclusive single lever headstock control...



This is how easy it is to operate

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More Speeds – Greater Range – The new eight-speed headstock (16 with a two-speed motor) gives you more speeds in a wider range – from 45 to 2262 rpm – for maximum metal removal efficiency.

Instant Speed Changes are made possible through exclusive, Warner & Swasey designed direct-acting hydraulic clutches (which never need adjustment) in combination with a constant mesh, helical gear train.

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Exclusive, Single Lever Preselector and Speed Control

On the new No. 3, preselection of speeds, speed change, brake and neutral are all obtained with the same lever.

No fumbling for speeds ... no gear shifting. Just rotate the handle to preselect; move it up or down to engage new speed instantly.

No figuring ... the direct reading preselector dial tells you the surface speed for each diameter and rpm.

No remembering (or forgetting) ... the preselector drum lets you set up the sequence of cuts; numbered clips tell you where to find the speeds and their order of use.

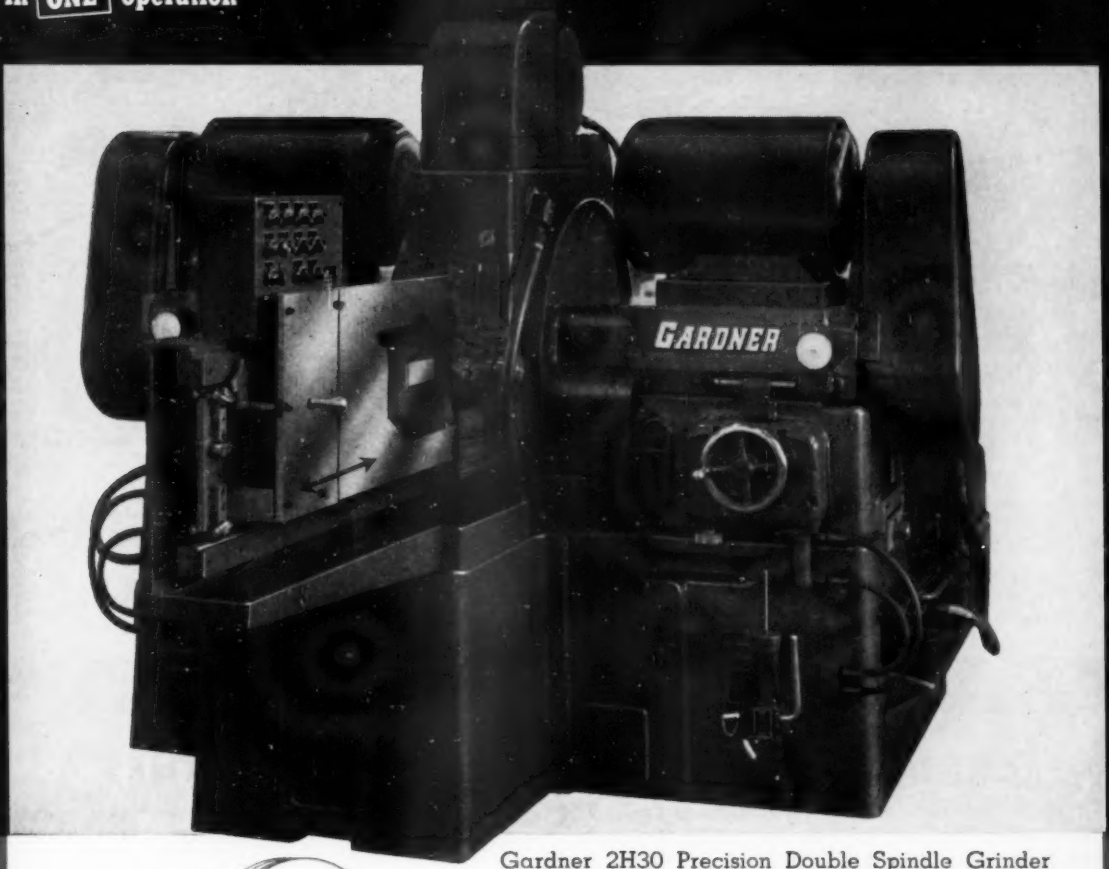
Neutral (free spindle) and Brake are selected by rotating lever to the left.

Warner & Swasey Co.
Cleveland 3, Ohio

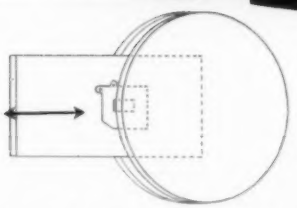
You can produce it better, faster, for less... with a WARNER & SWASEY

Gardner gun type fixturing lowers costs in grinding large area and odd shaped parts

surface grinds TWO sides parallel in ONE operation



Gardner 2H30 Precision Double Spindle Grinder with gun type fixturing.



Typical large parts ground with gun type fixturing:
clutch races, bearing cones, valve plates, separator plates, deposit box doors, pump rings.

Advantages of Gardner reciprocating gun type fixturing

- heavy stock removal
- work holding paddles easily interchangeable
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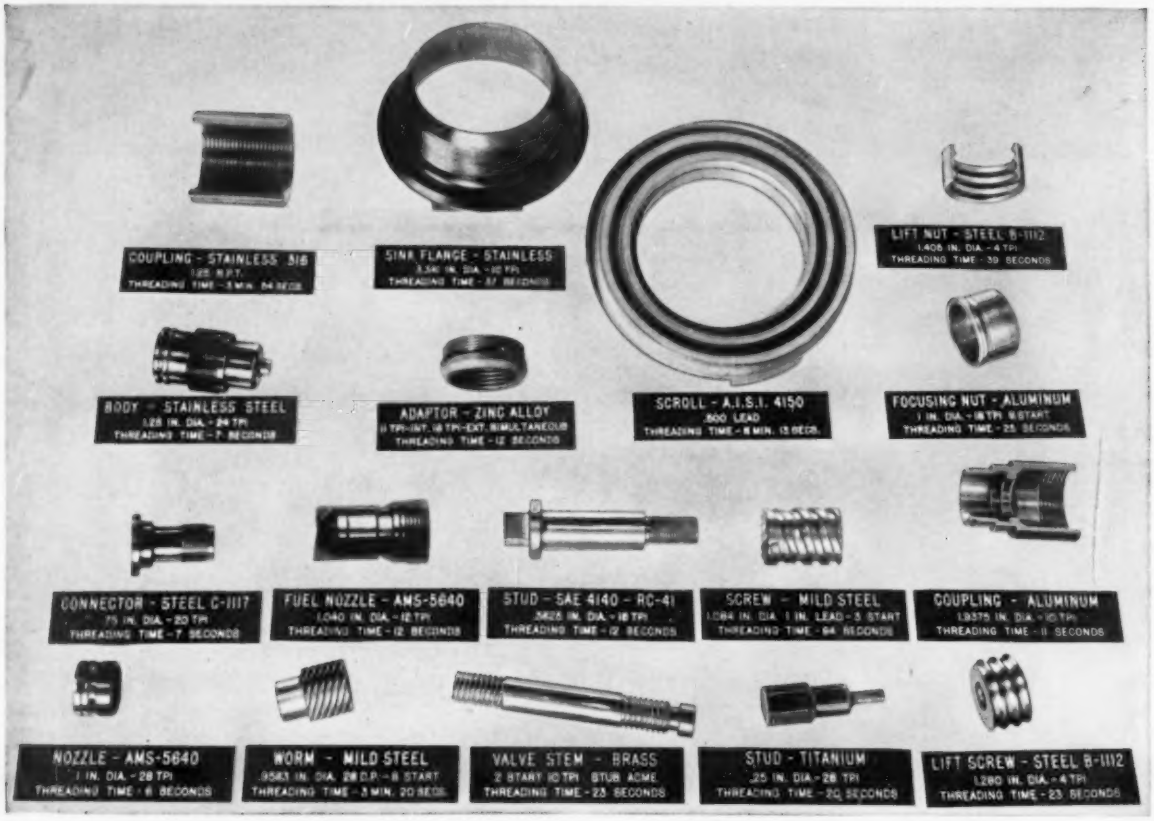
COUPLING - STAINLESS 316
SINK FLANGE - STAINLESS
LIFT NUT - STEEL B-1112
1.408 IN. DIA. - 4 TPI
THREADING TIME - 39 SECONDS
BODY - STAINLESS STEEL
.128 IN. DIA. - 24 TPI
THREADING TIME - 7 SECONDS
ADAPTOR - ZINC ALLOY
SCROLL - A.I.S.I. 4150
.800 LEAD
THREADING TIME - 8 MIN. 15 SECS.
FOCUSING NUT - ALUMINUM
1 IN. DIA. - 18 TPI 16 START
THREADING TIME - 25 SECONDS
CONNECTOR - STEEL C-1117
.75 IN. DIA. - 20 TPI
THREADING TIME - 7 SECONDS
FUEL NOZZLE - AMS-5640
1.040 IN. DIA. - 12 TPI
THREADING TIME - 12 SECONDS
STUD - SAE 4140 - RC-41
.5625 IN. DIA. - 18 TPI
THREADING TIME - 12 SECONDS
SCREW - MILD STEEL
1.084 IN. DIA. 1 IN. LEAD - 3 START
THREADING TIME - 94 SECONDS
COUPLING - ALUMINUM
1.9375 IN. DIA. - 10 TPI
THREADING TIME - 11 SECONDS
NOZZLE - AMS-5640
1 IN. DIA. - 28 TPI
THREADING TIME - 6 SECONDS
WORM - MILD STEEL
.9583 IN. DIA. 28 D.P. - 6 START
THREADING TIME - 3 MIN. 20 SECS.
VALVE STEM - BRASS
2 START 10 TPI STUB ACME
THREADING TIME - 23 SECONDS
STUD - TITANIUM
.25 IN. DIA. - 28 TPI
THREADING TIME - 20 SECONDS
LIFT SCREW - STEEL B-1112
1.280 IN. DIA. - 4 TPI
THREADING TIME - 23 SECONDS

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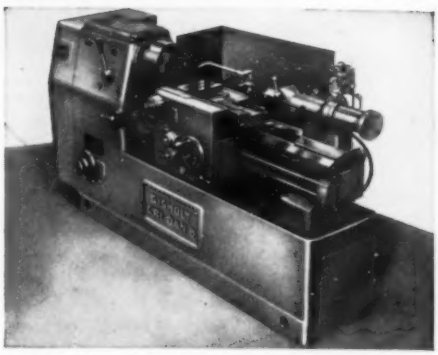

Two models are available. The smaller Model B (shown) offers extreme flexibility with spindle speeds of from 154 to 2808 r.p.m.; 3' capacity between centers and 15½" swing over bed. Rugged saddle supports fast-acting threading slide, easily positioned along bed. Complete change-over from job to job can be made in 15 minutes.

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- **TOLERANCES DOWN IN THE MILLIONTHS**
- **INCREASED PRODUCTION**
- **LOWER COSTS**

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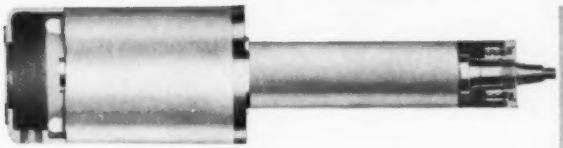

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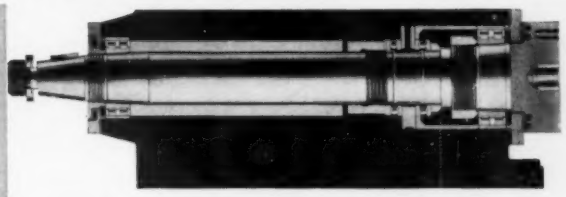
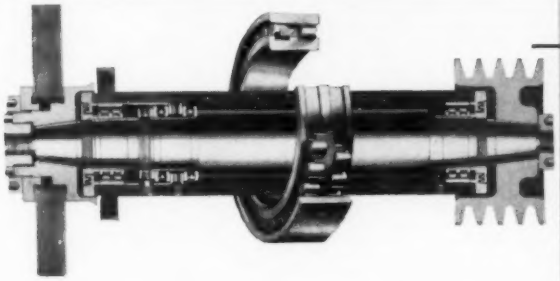
POPE 1, 2 and 3 HP, Totally Enclosed 1800 and 3600 RPM Motorized, Cartridge Type Spindles with massive shafts and big, double row cylindrical roller bearings having enormous capacity, superior performance and long life.



FOR BORING ROUND HOLES WITHIN MILLIONTHS OF AN INCH

POPE Heavy Duty Boring Spindles for smooth, chatter free, continuous high production of accurate parts. Again, look at the big cylindrical roller bearings and thrust bearings.



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POPE Spindles have the double row cylindrical roller bearings for the extra rigidity to support the cutting tool, and the double direction thrust bearings with the excess capacity to stabilize the shaft against endwise movement in either direction. This adds up to longer cutting tool life, more production, lower cost per piece.

POPE engineers and builds standard and special, precision anti-friction bearing Spindles for every purpose. Send us your specifications for prompt quotations.

No. 115

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LANDIS
precision grinders

LANDIS TOOL COMPANY / WAYNESBORO, PENNSYLVANIA

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A New Approach

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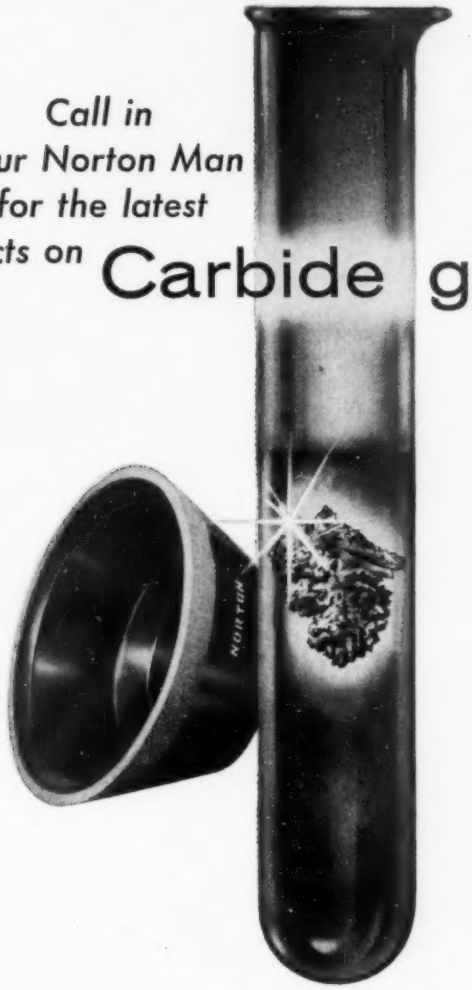
Carbide grinding with Norton wheels

using mined or man-made diamonds



Magnified View of a man-made diamond. The extremely jagged surface provides a large, tight-holding contact area for bonding. In the new Norton SD* wheels this extra gripping power, teamed with advancements in diamond wheel construction, reduces diamond loss and carbide loading to a minimum — typical of Norton leadership in getting the maximum working power out of all diamonds, mined or man-made.

Norton diamond wheels — the most complete line for carbide grinding — are backed by pioneering never equalled, whether the diamonds used are mined or man-made.

Norton began its leadership in diamond wheel development back in 1930 . . . introduced all three bond types . . . does all its own sizing and checking of diamonds . . . duplicates wheel specifications with constant accuracy.

Norton leadership continues with the use of man-made diamonds. These newest diamonds last longer for many carbide grinding operations because they are more firmly anchored in the bond . . . and because their greater friability presents new cutting edges faster, decreasing power requirements and speeding cutting action.

Man-made diamonds are used to fullest advantage in the new Norton SD* wheels — proved in more than a year of nationwide, comparative testing . . . *In 63% of hundreds of field tests the average service life of Norton SD diamond wheels was at least 25% longer than the life of wheels using natural, mined diamonds.*

With each Norton diamond wheel, of mined or man-made diamonds, you get a certificate of the accuracy of diamond concentration. You can depend on this certificate to mean exactly what it says.

You can depend on your Norton Man, too. This expert Abrasive Engineer can show you how to get better grinding quality, longer service life and lower cost grinding for every dollar you spend on diamond wheels. NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

*Man-made diamonds W-1944

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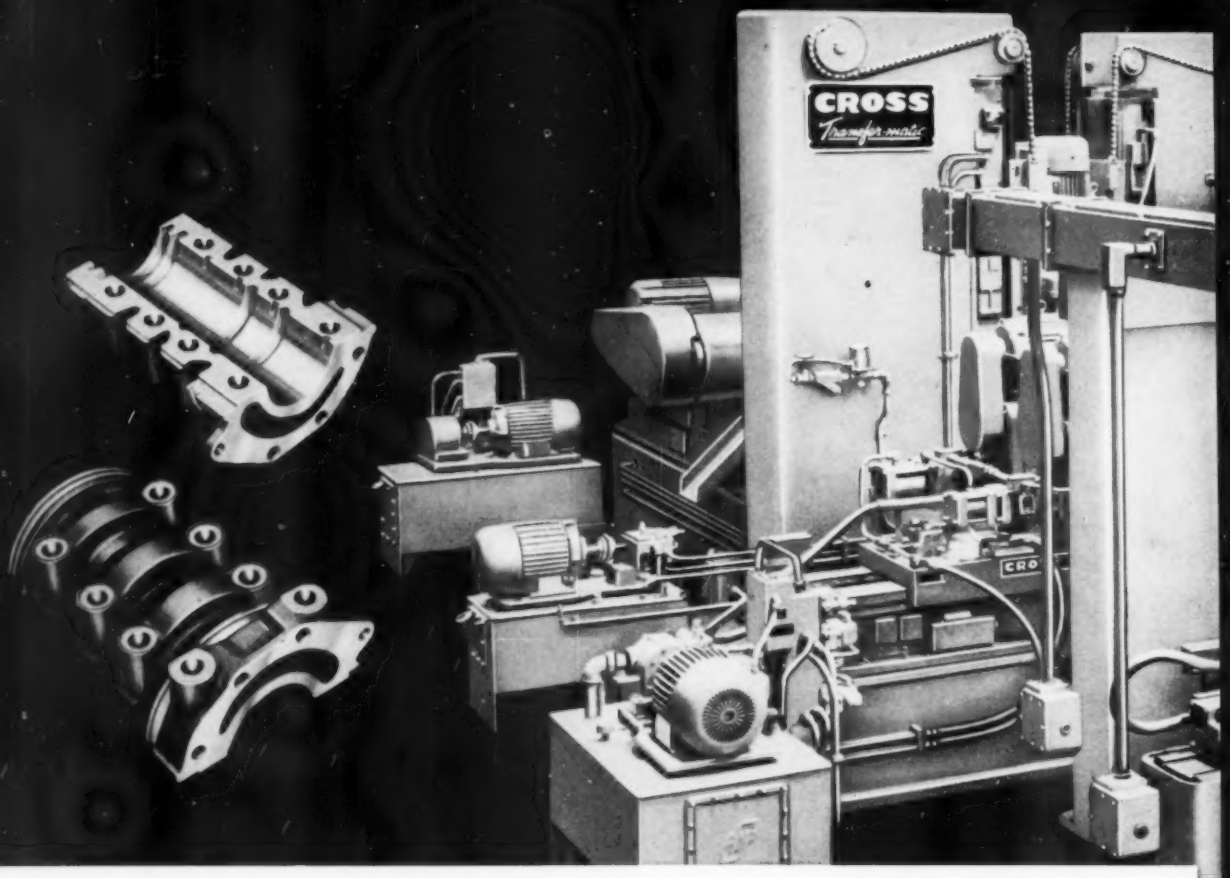
NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electro-Chemicals — BEHR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

A New Approach For Processing Crankshaft Bearing Caps



This Cross Transfer-Matic, built for an European automotive company, provides an entirely new approach to machining crankshaft bearing caps. Capacity of the 30 station machine is 109 sets (436 pieces) per hour at 100% efficiency.

The parts, cast in clusters of four, are broached in preparation for the operations performed by the Transfer-Matic. Unlike American designs, the No. 1 and 4 caps require felt seal grooves and the No. 1 cap has a pattern of four holes in the end for mounting a fan belt cover.

New Methods

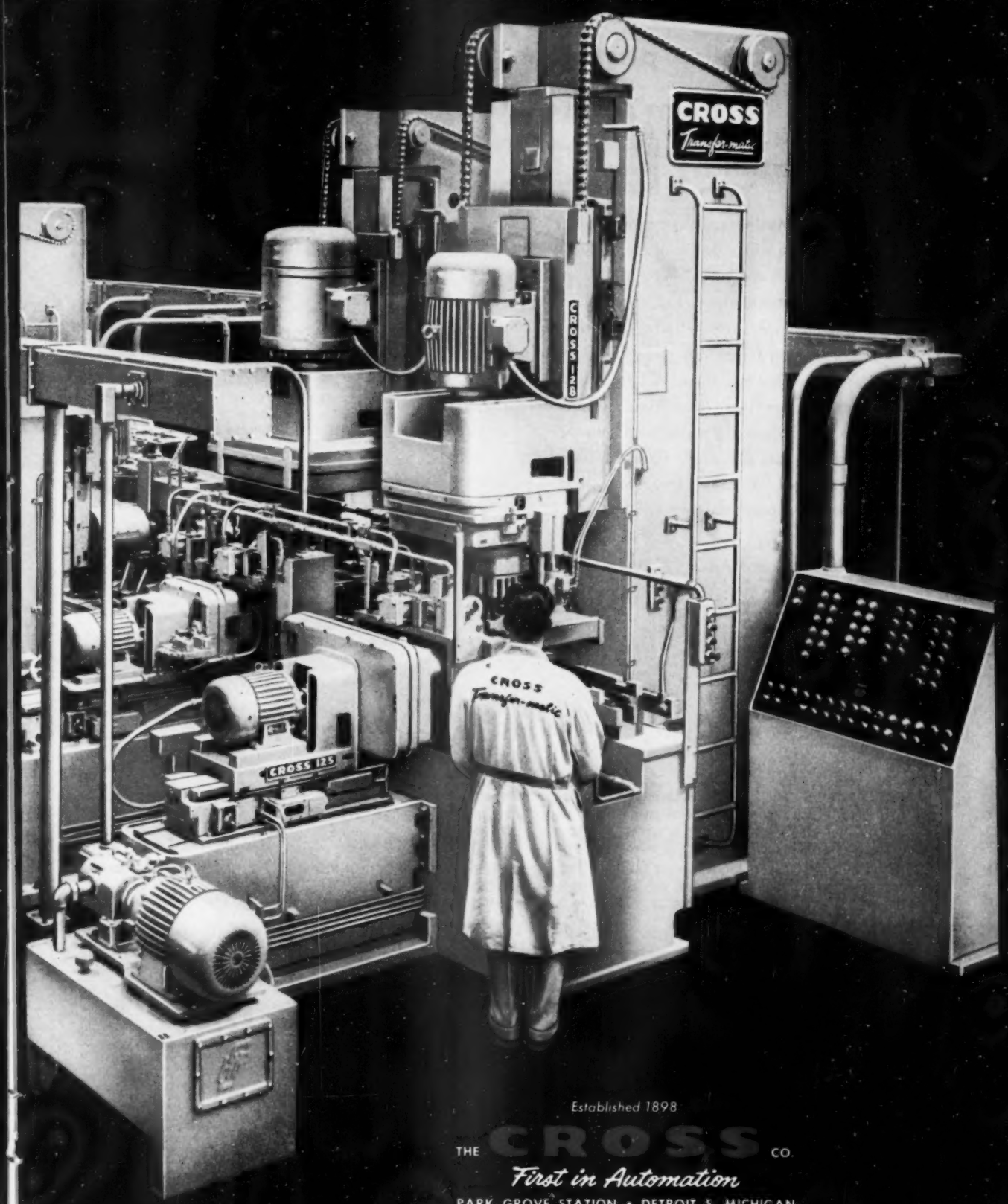
The clusters are indexed by a lift and carry transfer mechanism with the crankshaft axis at right angles to the transfer movement. The felt seal grooves are machined by standard cross-facing heads mounted on horizontal positioning units. The fan belt cover hole operations are also performed horizontally. The bolt holes, bearing lock notches, oil slinger grooves and the milling of a lug on the No. 1 bearing cap are all machined vertically.

New Sawing Unit and Fixture

At the very end of the machine, the clusters are shuttled into a special sawing fixture where they are cut into individual pieces and ejected. The fixture, a new design, holds the parts with the joint face at a 40° angle. This arrangement permits the chips to fall free of the clamping mechanism and substantially reduces the overhang of the sawing cutters. During the sawing operation, locating pins are inserted in all of the bearing cap bolt holes to provide maximum rigidity and to prevent pinching of the saws as they withdraw from the work.

The machine is constructed to JIC Standards, has complete interchangeability of all standard and special parts, and is constructed out of standard Cross building blocks for optimum flexibility. A Cross Machine Control Unit equipped with Toolometers programs tool changes to reduce machine downtime. All tools are pre-set in standard Cross tool setting fixtures.

Another Automation First by Cross



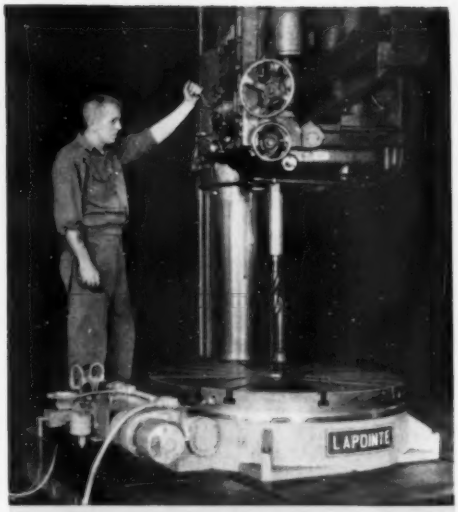
Established 1898

THE CROSS CO.

First in Automation

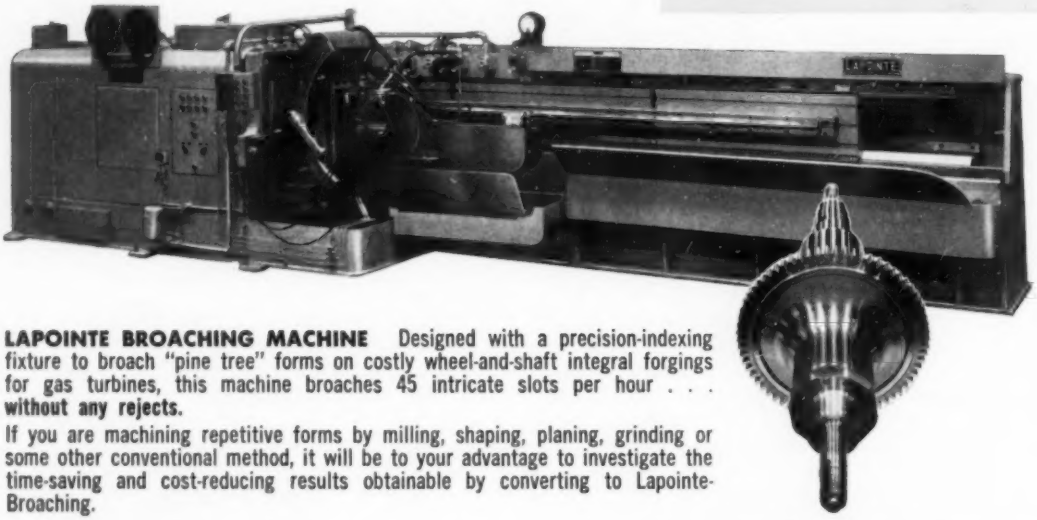
PARK GROVE STATION • DETROIT 5, MICHIGAN

You get real "blue chip" performance from these tools built by LAPOINTE



LAPOINTE ROTOMATIC POSITIONER Accuracy guaranteed within 5 seconds of arc of true position (Series "A" machine). In view of the pressing need for a combination rotating table and indexing fixture that would perform with extreme accuracy, Lapointe designed and built this machine in seven standard diameters from 24" to 84". It can take loads up to 25 tons without loss of precision or accuracy; load need not be balanced; machine can start at full load. Can operate by card or tape system. Illustration shows the 48" Lapointe Rotomatic Positioner adapted to a standard radial drill.

BROACHING Machines, and the other tools built by Lapointe, function with a degree of accuracy that is unequalled elsewhere. That's understandable, since they are created from an engineering background represented by nearly 60 years of uninterrupted experience—all of it in the field of broaching. **If you're looking for performance,** Lapointe machines will give it to you, day in and day out, year after year. Lapointe has become known as "Broaching Headquarters" by the large — and small — production plants throughout America. In changing times like these, what counts the most is *character.* It's an old-fashioned virtue which gives the purchaser of a machine a comfortable feeling of confidence.



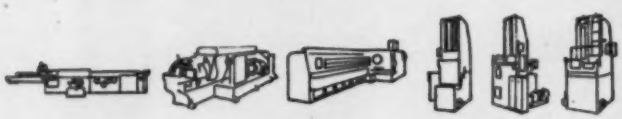
LAPOINTE BROACHING MACHINE Designed with a precision-indexing fixture to broach "pine tree" forms on costly wheel-and-shaft integral forgings for gas turbines, this machine broaches 45 intricate slots per hour . . . **without any rejects.**

If you are machining repetitive forms by milling, shaping, planing, grinding or some other conventional method, it will be to your advantage to investigate the time-saving and cost-reducing results obtainable by converting to Lapointe-Broaching.

THE LAPOINTE MACHINE TOOL COMPANY

HUDSON, MASSACHUSETTS • U.S.A. *In England: Watford, Hertfordshire*

THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHING MACHINES AND BROACHES



LAPOINTE

known to be the best in

BROACHING

BUSHINGS...

on the Rocks!

It's "refreshing" to know — American provides drill jig bushings for every tooling purpose. We serve them to your "taste", to satisfy your job requirements. This is an *American* tradition.

Your local exclusive American distributor can fill your order for practically any size or type of bushing, right from his shelf. *You can depend on American* for precision drill jig bushings, engineered to fit your needs precisely.

Write for FREE Catalog. Its easy selection tables make ordering the correct bushing a snap.

American

DRILL BUSHING CO. • 5107 Pacific Blvd. • Los Angeles 58, Calif.

Easy To Machine and Harden, Ideal For Intricate Parts

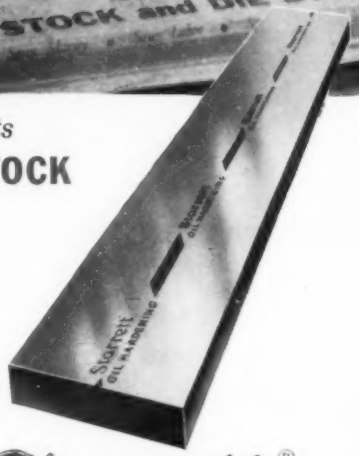
STARRETT No. 496 OIL HARDENING FLAT STOCK

Here is a deep hardening chromium-tungsten-vanadium tool steel with excellent non-deforming characteristics — ideal for intricate or thin section work where you normally worry about cracking or distortion.

Starrett No. 496 precision ground Oil Hardening Flat Stock and Die Stock is fully spheroidized for easy machining with a low (1450°-1500°) *non-critical* hardening range, exceptional deep hardening characteristics and fine grain structure. Available in a complete range of flat stock and die stock sizes through your Industrial Supply Distributor.

Your distributor also has Starrett *air hardening* and *water hardening* tool steel flat stock and die stock and Starrett *free machining-low carbon* flat stock, a fine grained, low carbon, silicon killed steel with 91% machinability. To save valuable man-hours and machine time, choose the exact widths and thicknesses you need from over 1000 sizes — then just lay it out and cut it out.

Ask your distributor for complete information — or write for Bulletins 1109 and 1110. Address Dept. E, The L. S. Starrett Company, Athol, Massachusetts, U. S. A.



Starrett®

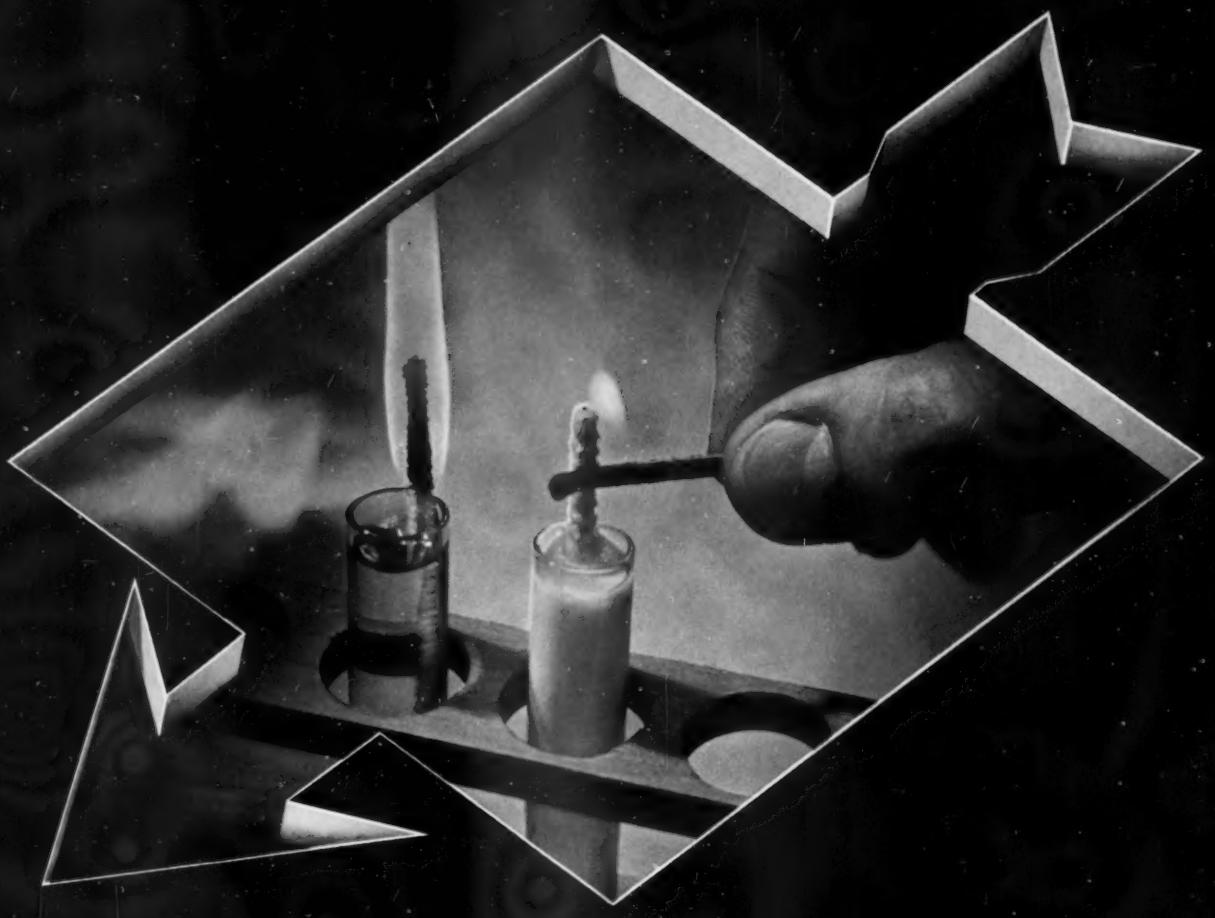
PRECISION GROUND FLAT AND DIE STOCK

World's Greatest Toolmakers

Starrett Precision Makes Good Products Better

PRECISION TOOLS • DIAL INDICATORS • STEEL TAPES • GROUND FLAT STOCK • HACKSAWS • HOLE SAWS • BAND SAWS • BAND KNIVES

Quality... the best economy of all



Another product of Sunoco research... a fire-resistant hydraulic fluid

The flame test, above, dramatizes the effectiveness of Sun's new fire-resistant hydraulic fluid. The wick in the conventional fluid burns readily; the wick in Sun's new fluid just can't be lighted.

SUNSAFE, a water-in-oil emulsion, eliminates fire hazards . . . provides increased safety to personnel and equipment. At the same time, operators get the essential performance characteristics of a top-grade hydraulic oil—low rates of wear, long service life, and protection against rust and corrosion.

This combination of *quality* in engineering know-how, and *quality* in product, proves once again that *quality* in any sense is the best economy of all.

For 73 years Sunoco has meant quality right down the line. Today, this quality is found in more than 400 Sunoco industrial products. SUN OIL COMPANY, Phila. 3, Pa., Dept. I-14. In Canada: Sun Oil Company Limited, Toronto and Montreal.

MAKERS OF FAMOUS CUSTOM-BLENDED BLUE SUNOCO GASOLINES

SUNOCO®

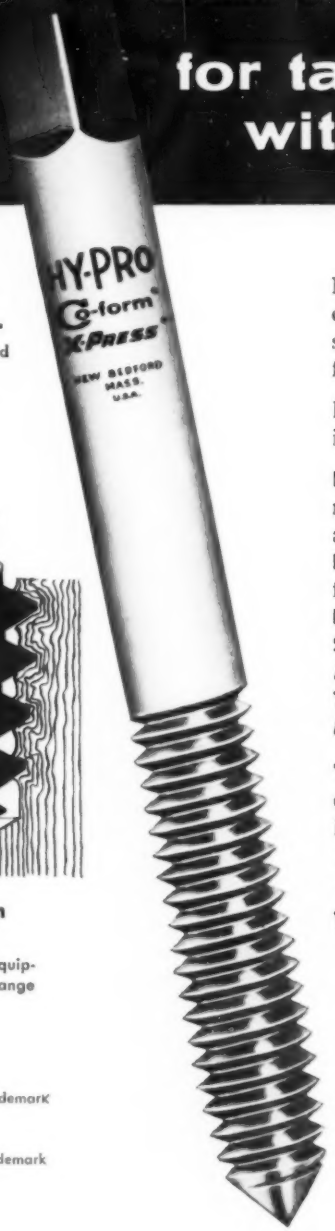
PRINTED IN U.S.A.

Announcing **HY-PRO**

Co-form® X-PRESS® TAPS

Manufactured under exclusive license from Besley-Welles Corp.

for tapping threads without cutting



Recommended for tapping . . .

Copper Brass Lead
Aluminum Zinc
Steel Magnesium
Die Castings
Leaded Steel
Cast Steel
Stainless Steel
Mehanite
— other ductile metals

Tapping operation is the same

Conventional methods and equipment are used, except for change to larger tap drill sizes.

® Co-form is a registered trademark of Hy-Pro Tool Co.

® X-Press is a registered trademark of Besley-Welles Corp.

NOW — from HY-PRO you can get the newest in tap design — Co-form X-Press fluteless taps that are setting cost-reduction records on many jobs that were formerly "tap-killers"

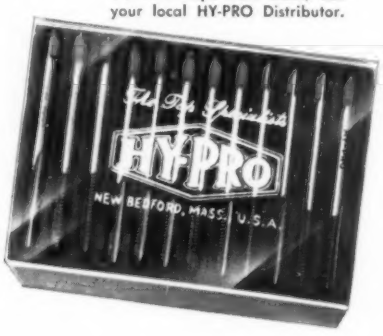
HY-PRO Co-form X-Press taps cold-form threads in through or blind holes, with these advantages . . .

No Chips to clog and cause tap breakage — no chip removal problems • **Permit Faster Tapping Speed** and boost production from automatic equipment **Provide Accurate Control** of hole size — cannot be forced into lead error • **Eliminate Blind Hole Tapping Problems** — no chips to jam at bottom • **Form Stronger Threads** with better holding power • **Taps Are Stronger** without flutes, especially in smaller sizes **Taps Last Longer** and maintain accurate size tolerance **More Holes Per Tap** — up to 40 times greater tap life.

Try HY-PRO Co-form X-Press taps on your toughest tapping operations. For complete application information, call your HY-PRO Distributor or write: HY-PRO Tool Company, Dept. C, New Bedford, Mass.

Tap for less with Co-form® X-Press®

For the complete line of HY-PRO standard taps from stock, call your local HY-PRO Distributor.



HY-PRO

HY-PRO TOOL COMPANY
NEW BEDFORD, MASS., U. S. A.

CINCINNATI

Elektrojet®
ELECTRICAL DISCHARGE MACHINE

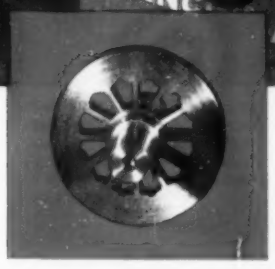
ELEKTROJET

GIVES YOU A NEW CONCEPT OF ELECTRICAL DISCHARGE MACHINING

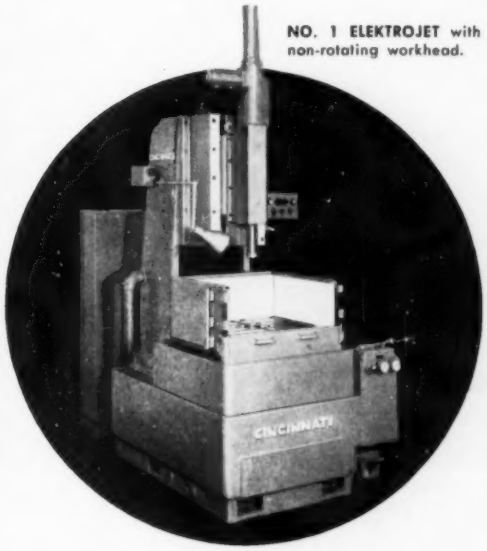
Opportunities to reduce costs are numerous in electrical discharge machining (EDM). It is impartial to hardness of the work, to complexity of the machined surface, and to fragility of the work. Now Cincinnati greatly extends the possibilities of the method with a new line of Elektrojet EDM Machines, providing the added dependability of sturdy machine tool construction.

EDM is inherently accurate and Cincinnati's machine tool approach makes sure that the full degree of accuracy is obtained. Another reason for heavy construction is the appreciable force created by electrical discharge machining of large areas. Other Elektrojet advantages include Cincinnati's long experience in hydraulics and servo controls; the Elektrojet customer service laboratory, where you can determine the value of EDM for your work; Elektrojet specialists, who have a machine tool background second to none.

There are 35 variations in the Elektrojet line, covering the requirements of unusual or "impossible" machining operations on a wide variety of parts ranging from small missile components to forging dies. Folder M-2077, containing complete information, will be sent on request. **Milling Machine Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.**



SILENTLY, WITH TOKEN ATTENTION, Elektrojet works quickly and efficiently to perform operations which are impossible or too expensive for other machines. At left is a small missile part of pure beryllium, 7/8" major diameter. In just five minutes twelve triangular-shaped holes are electrical discharge machined simultaneously.

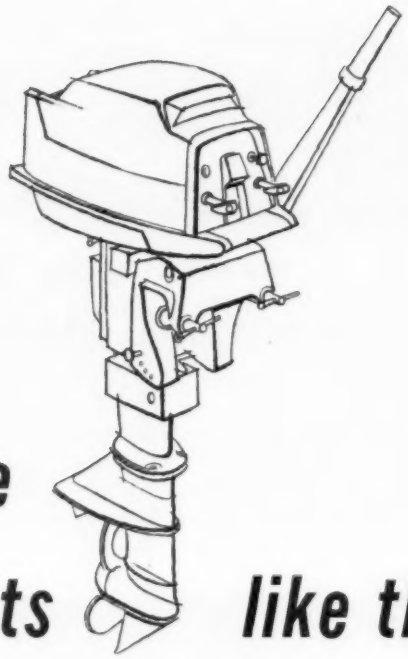


NO. 1 ELEKTROJET with non-rotating workhead.

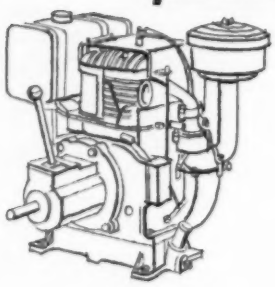
KNEE TYPE AND BED TYPE MILLING MACHINES • DIE SINKING MACHINES
• CUTTER AND TOOL GRINDERS • ELECTRICAL DISCHARGE MACHINES

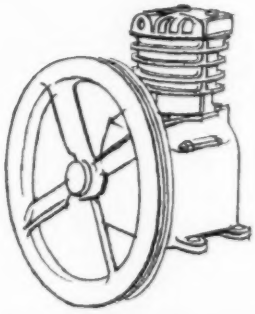
USE READER SERVICE CARD, CIRCLE 16

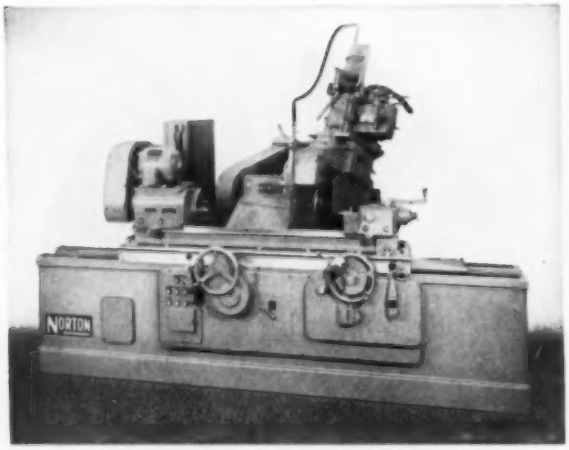
CINCINNATI
MILLING MACHINE DIVISION



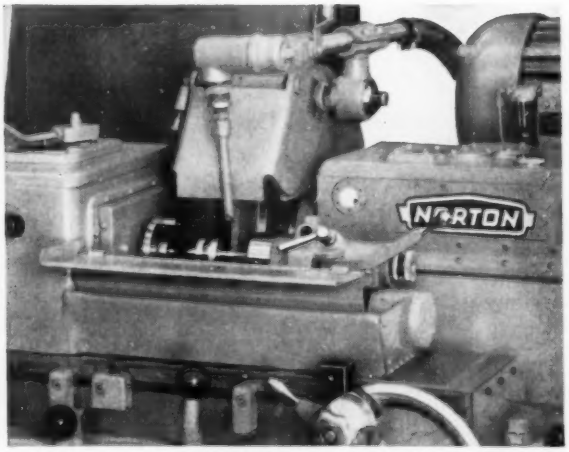
If you make products like these.....





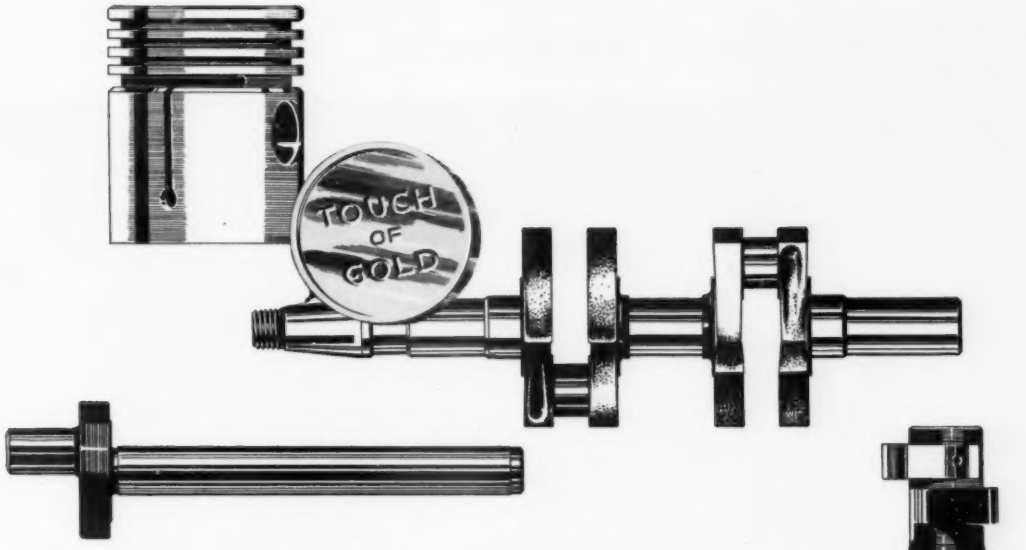


A Norton Type CV-4 Angular Wheelslide Grinder, 10" semiautomatic, grinds the bearing diameters and adjacent shoulders of the outboard engine crankshaft shown above. Two other Norton machines are used in grinding this part: a 10" Type LCTU for the center main bearing and a 10" Type CTU CRANK-O-MATIC* crankpin grinder for the throws.



A Norton CAM-O-UNIT* Mechanism attached to a Norton Type CTU cylindrical grinder. This smooth-working grinding team broadens the scope of a proved cylindrical grinder, assuring excellent, low-cost grinding of the small piston and the motorcycle camshaft shown, as well as other special shapes.

*Trade-Mark Reg. U.S. Pat. Off. and Foreign Countries



grind parts like these...

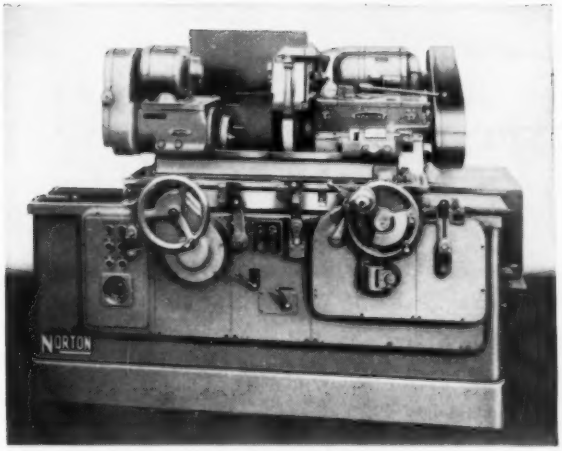
on NORTON machines

The longer it takes you to grind parts for popular, mass-produced products, the more it costs you. If your grinding machines are below par, so are your profits.

Norton grinders can help you cut production time and costs to the very lowest. You have plenty to choose from — cylindrical, angular, crankpin and other grinder types, together with CAM-O-UNIT mechanisms that enable CTU machines to grind cams and special shapes with precision accuracy.

Norton grinders — all of them — are engineered for fast, accurate, easy operation, simplified maintenance and long, trouble-free service life. By combining several grinds in one job, a single Norton machine for your production can easily replace two or more ordinary grinders.

Your Norton Man, an expert grinding engineer, is always ready to help you select the grinding equipment you need to improve product quality and build your profits. NORTON COMPANY, Machine Division, Worcester 6, Mass. District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit. *In Canada:* J. H. Ryder Machinery Co., Ltd., Toronto 5.



A Norton Type CTU Cylindrical Grinder, 6″ x 18″ semiautomatic, with live spindle headstock, is used for grinding the household refrigerator compressor shaft, shown above. Areas ground are the short off-set diameter, the shoulder and part of the shaft — typical of the Type CTU's ability to perform several grinding operations at one time.

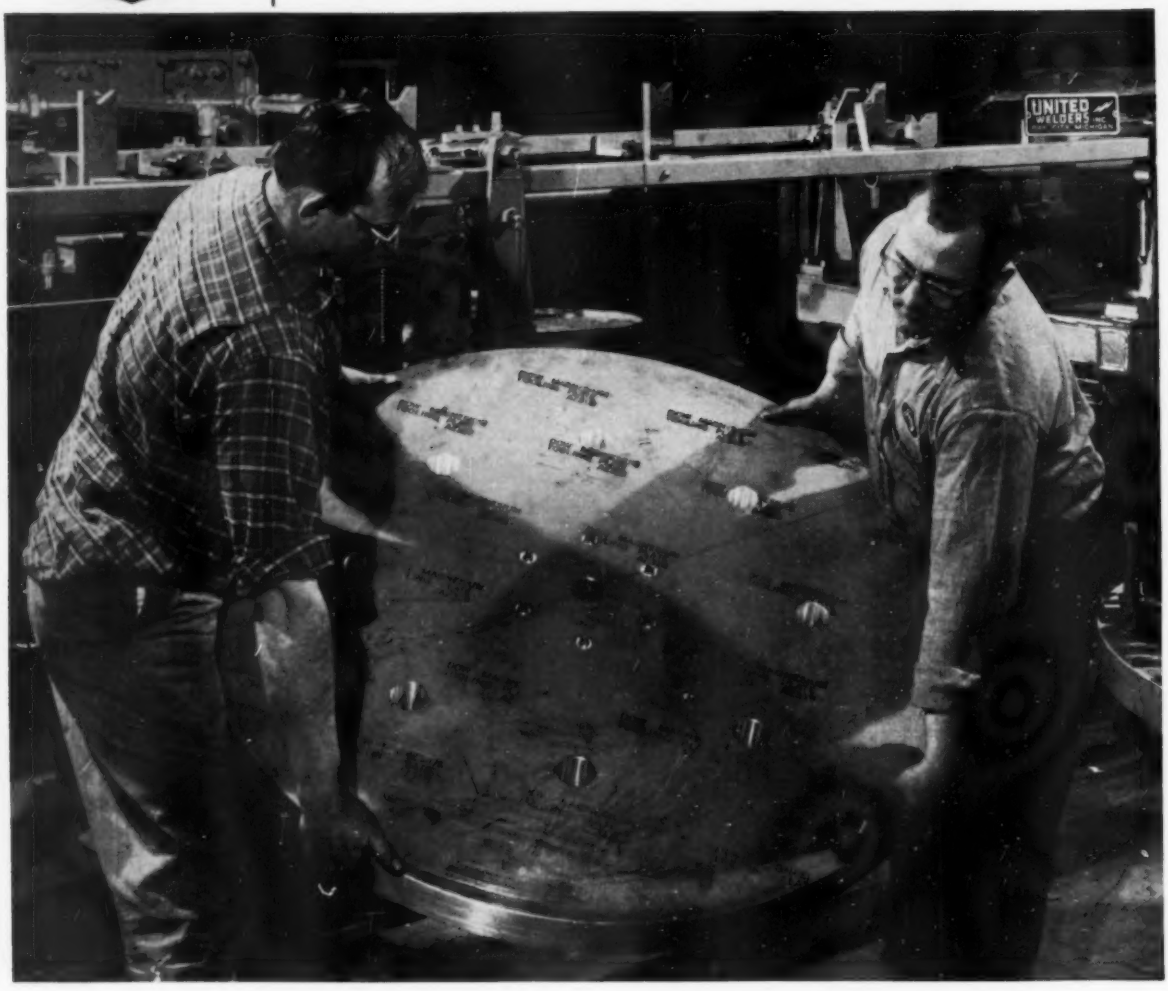
NORTON

GRINDERS and LAPPERS

Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electro-Chemicals — **BEHR-MANNING DIVISION:** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

DOW | METAL PRODUCTS

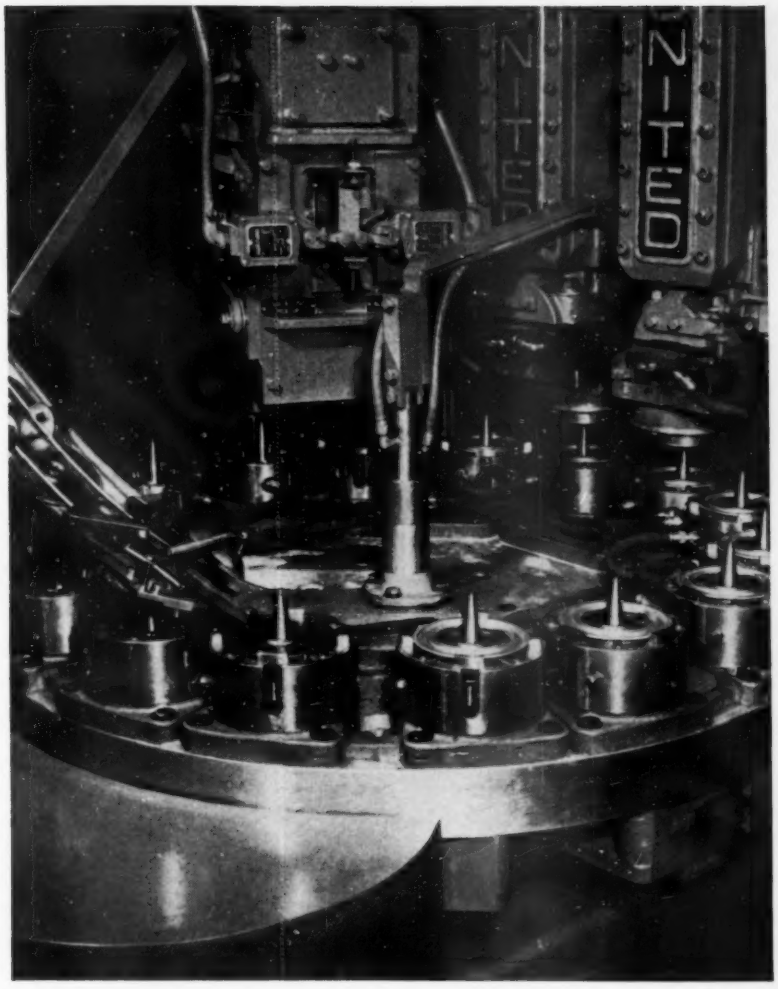


10¢ PHONE CALL CUT MACHINING TIME 50% ON 3-FT. INDEX TABLE!

Ordered-by-phone magnesium tooling plate disc replaced cast steel index table for machinery manufacturer . . . "as purchased" flatness cut previous machining time on this part in half . . . saved 50% on machining costs.

United Welders Inc., of Bay City, Michigan, recently replaced steel with magnesium tooling plate in making the precision index table, or dial, for their automatic 8 Station Dual Dial Welder. This machine is used in welding the bottom gasket retainer for an oil filter assembly in 1959 automobiles.

The dials previously were made of cast steel which required costly, time-consuming surface and edge machining to finish. The 2½ inch by 36 inch dials of magnesium tooling plate are now purchased rough-cut to size from the local Dow magnesium distributor, and are finished by simply edge truing and drilling. Because the as-purchased flatness completely eliminates need for surface machining, United's machining costs on this part have been cut by more than half. Production has been speeded, too, because magnesium's light weight makes the dials easy to handle during manufacture. Two men can easily lift and handle the light disc. Cranes or lift trucks aren't needed as they were with the previous steel dials.



Because magnesium tooling plate is uniformly flat, it can be used for almost all tooling jobs without surface machining. It's rolled and thermal flattened to close flatness tolerances . . . high dimensional stability keeps it flat in use.

MAGNESIUM TOOLING PLATE IS AVAILABLE FROM STOCK AT:

E. F. Bailey Company
Seattle, Washington

Clendenin Bros., Inc.
Baltimore, Maryland

Copper and Brass Sales, Inc.
Cleveland, Ohio; Detroit 12, Michigan

Fullerton Steel and Wire Company
Chicago 35, Illinois

Hubbell Metals Inc.
St. Louis 3, Mo.; Kansas City, Mo.; Marietta, Ga.

A. R. Purdy Co., Inc.
Lyndhurst, New Jersey

Reliance Magnesium Company
Los Angeles 58, California

Joseph T. Ryerson & Son, Inc.
Dallas, Texas

LIGHTNESS CUTS POWER NEEDS 75%

In the United welder above, the dial starts and stops 500 times per hour during welding operations. This lightweight magnesium dial requires only a quarter of the power needed to operate the previous steel dial. It permits a drastic reduction in the cost and size of motor, speed reducer and other necessary driving elements.

RIGIDITY MEANS ACCURATE POSITIONING

United Welders employs a Geneva Stop Movement to position parts accurately under dual automatic spot welding heads. Magnesium's rigidity helps the dial retain close tolerances necessary for continued accuracy.

Magnesium tooling plate has other advantages, too. It costs less to buy than other lightweight tooling materials and can easily be welded. It can often be obtained ready-cut-to-shape from distributors, saving additional time in your shop.

There's a wealth of information in Dow's new magnesium tooling plate manual. This handy 56-page book is filled with facts about shop working characteristics, machining, etc. For a copy, contact your Dow branch office or write to THE DOW METAL PRODUCTS COMPANY, Sales Department 1331FJ10.

THE DOW METAL PRODUCTS COMPANY, Midland, Michigan

DIVISION OF THE DOW CHEMICAL COMPANY

MORSE

helps to make

MACK mighty...

two famous names noted for

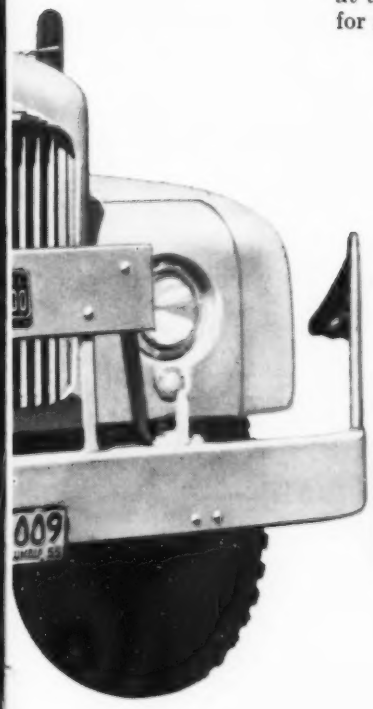
GUTS

Mighty Mack Trucks . . . and the Morse cutting tools used to make them . . . are equally famous for *guts*. Mack on the road. Morse on the production line. Proof once again that to build the best you must build *with* the best.

Sound economics? Sure. Longer lasting more efficient tools *invariably* produce long-run economy.

Why not prove it to yourself. Your Morse-Franchised Distributor will gladly demonstrate to you the *practical* economics of buying the best in cutting tools . . . Morse, of course. *Call him in today.*

P.S. If you want to get the most out of the best twist drills made today, take a look at the Morse Production Drill Point Grinder. It *outpoints all other* machines. Write for new illustrated bulletin.



Morse CUTTING TOOLS

MORSE TWIST DRILL & MACHINE COMPANY
NEW BEDFORD, MASSACHUSETTS

WAREHOUSES IN NEW YORK, CHICAGO, DETROIT, DALLAS, SAN FRANCISCO

A Division of VAN NORMAN INDUSTRIES, INC.

MORSE *means* "THE MOST" *in Cutting Tools*

2219

USE READER SERVICE CARD, CIRCLE 19

Reduce Costly Wear on Air Equipment

Pipe scale, pipe dope, condensate, emulsified and deteriorated compressor oil — all damaging to connected air equipment — are inherently present in all compressed air systems. Provide for the efficient removal of these contaminants and assure top performance from air actuated devices by specifying a Norgren Air Line Filter in your design.

- 99 Models to choose from — ⅛", ¼", ⅜", ½", ¾", 1", 1¼", 1½" pipe sizes.
- Choice of 4 Filter Elements — 74, 64 or 25 micron . . . 5 micron available in some sizes.
- Transparent or Metal Bowls
- Wide Operating Pressure Range — Top efficiency at pressures as low as 5 psi—as high as 250 psi for metal bowl type.
- Wide Operating Temperature Range—Metal bowl models extend temperature range to 200° F.
- Automatic or Manual Drain — Automatic drain eliminates maintenance cost for draining manually.
- Abrasive Solids and Corrosive Liquids — are removed from air lines, reducing equipment wear, repair and replacement costs.

NEW Clamp Ring FOR FASTER, EASIER MAINTENANCE

. . . most Norgren Filters now have a new, improved clamp ring, featuring a quick-opening spring clip that securely locks it in place — no tools required for servicing filters.

For complete information,
call your nearby Norgren Representative listed in your telephone directory — or WRITE FOR DESCRIPTIVE LITERATURE.

If it's Norgren . . . It's Dependable.

C. A. NORGREN CO.

3447 SO. ELATI STREET • ENGLEWOOD, COLORADO

4 AN

USE READER SERVICE CARD. CIRCLE 20

Two great cutting tool developments that mean

BETTER PROFITS THROUGH BETTER TOOLING

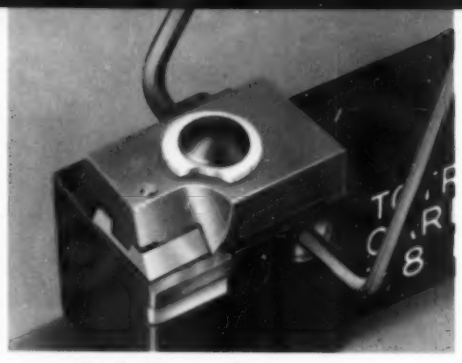
1 New Carboloy *Adjust-O-Breaker* toolholder lets you handle *MORE* jobs with *LESS* tooling!

2 *Hi-E* machining results in
. . . lowest cost-per-piece
OR
. . . reduced floor-to-floor time

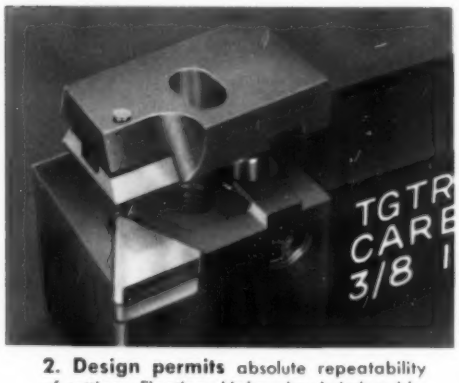
Plus the Carboloy line of disposable and brazed single-point tooling is the *BROADEST* in the industry!

Turn the pages for the full, exciting story!

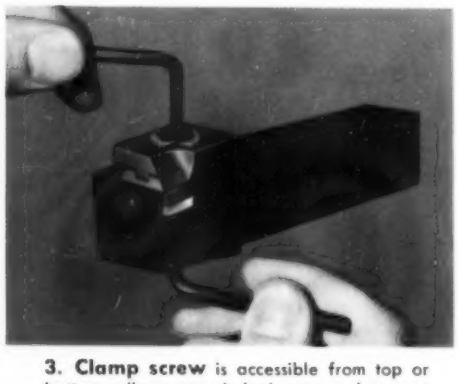
new



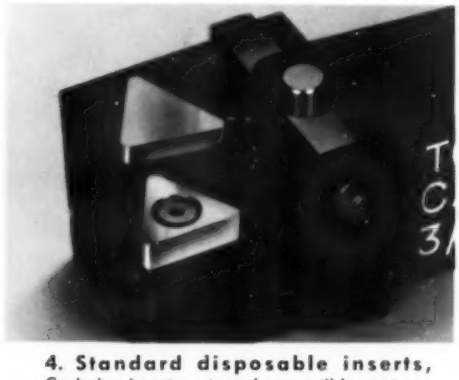
1. Chipbreaker setting is adjustable to any width within its range.* Set screw with two open ends provides access from either side. No springs to adjust.



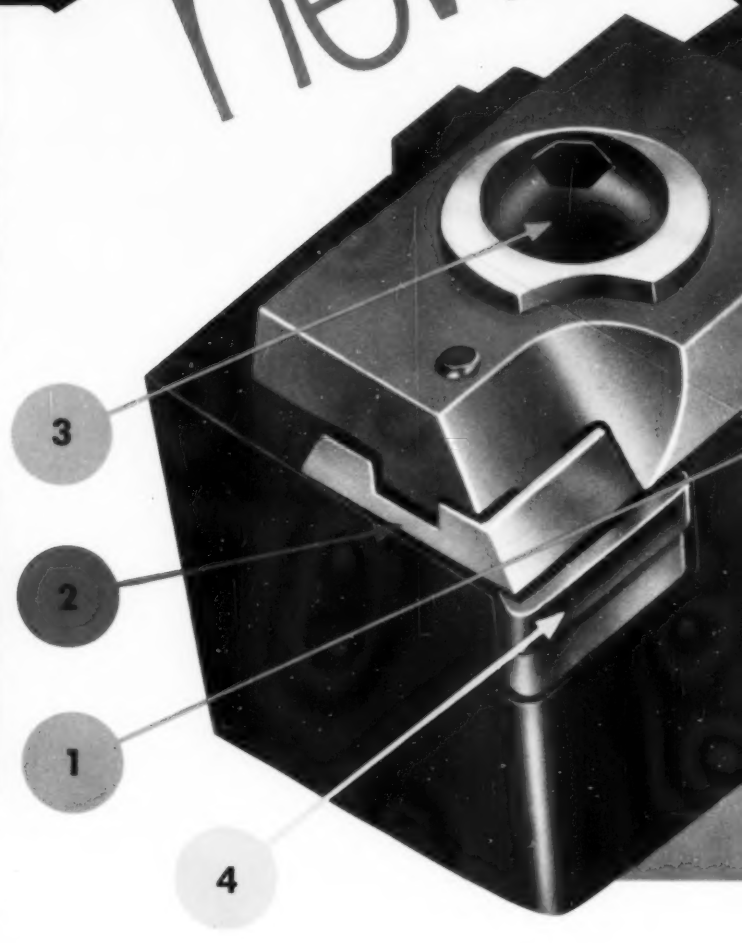
2. Design permits absolute repeatability of settings. Floating chipbreaker is indexable. Can't drop out when clamp is loosened.



3. Clamp screw is accessible from top or bottom; allows easy indexing or replacement even when toolholder is vertical or upside down.



4. Standard disposable inserts, Carboloy insert seats and convertible seat are used with toolholder. Insert seats are indexable and self-aligning.



General Ele
only Adjust-

CARBOLOY TOOLHOLDER WITH ADJUSTABLE CHIPBREAKER LETS YOU ADJUST FROM ANY ANGLE... OFFERS ANY DESIRED ADJUSTMENT WITHIN ITS RANGE*... FEATURES "FLOATING" INDEXABLE CHIPBREAKER WITH ABSOLUTE REPEATABILITY

*Sizes 16V and 85V: adjustable range 1/16" to 7/32"
Size 20V: adjustable range 1/16" to 11/32"

5. Most rugged adjustable toolholder on the market, the new Carboloy Adjust-O-Breaker offers all the advantages of fixed chipbreaker design PLUS any desired chipbreaker adjustment within its range.* Simple to use, it's the ultimate in toolholder versatility; offers minimum cutting-edge cost.

ectric announces the t-O-Breaker toolholder

MORE jobs with LESS tooling—that's what this new Carboloy Adjust-O-Breaker toolholder means! No need now to have a separate chipbreaker for every cutting job. No need, either, to limit yourself to toolholders with only two or three chipbreaker settings. Now you can have this versatile new Carboloy toolholder and adjust it for *any* chipbreaker setting within its range.*

Available from stock in 5 styles, negative rake, for left- and right-hand machining, the Adjust-O-Breaker holder brings new meaning to disposable tooling.

So, if you want to handle *more* jobs with *less* tooling, look into the complete Carboloy line—Lift-O-Matic (positive rake, negative rake, and tracer), heavy-duty, and the new Adjust-O-Breaker toolholder. Your Authorized Carboloy Distributor can supply you now. Check the Yellow Pages and give him a call today! Or write: *Metallurgical Products Department of General Electric Company, 11173 E. 8 Mile Road, Detroit 32, Michigan.*

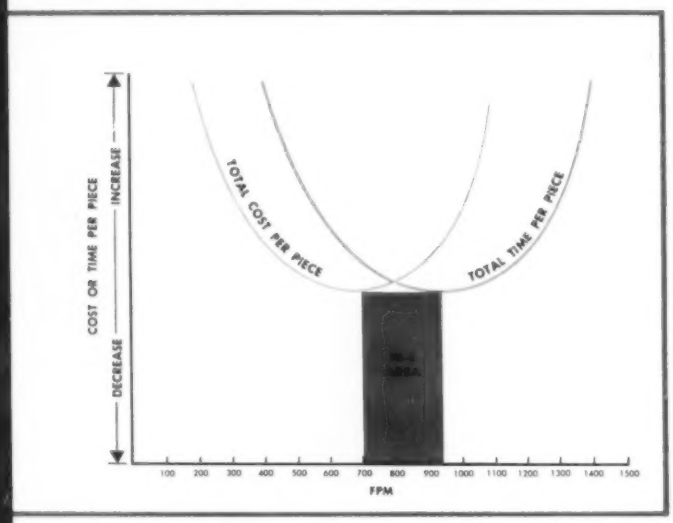
CARBOLOY
CEMENTED CARBIDES

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

AND...

Here's how Hi-E machining pays big dividends... giving you BETTER PROFITS THROUGH BETTER TOOLING


COST OR TIME PER PIECE
INCREASE
DECREASE
TOTAL COST PER PIECE
TOTAL TIME PER PIECE
100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500
FPM

Hi-E principle is illustrated by the curves on this chart. The low points of the two curves mark the boundaries of the high-efficiency range.

BROADEST TOOLING LINE IN THE INDUSTRY!

The complete quality line of Carboloy toolholders, inserts, insert seats, convertible seats, and brazed tooling is the broadest in the industry—designed to meet *every* tooling need!

Make your goal better profits through better tooling! Check with your Authorized Carboloy Distributor. He's listed in the Yellow Pages. *Metallurgical Products Department of General Electric Company, 11173 E. 8 Mile Road, Detroit 32, Michigan.*

In the light of current high manpower and equipment costs, carbide tools are low cost by comparison. Profitable operations result from the efficient combination of tool costs, manpower costs, and machine costs. In other words, tool costs should *not* be the only factor in setting up a job . . . rather, most efficient machining methods should be a major consideration. This calls for Hi-E!

Quickly defined, the Hi-E (**Hi**gh-**E**fficiency) machining practice brings together *all* factors to provide a range of cutting speeds for a given job to obtain (1) lowest cost-per-piece machined, or (2) reduced floor-to-floor time. Really, then, Hi-E machining can help you obtain the economical balance between *lowest possible cost* and *greatest possible production rate.*

The Hi-E area (see illus.) shows optimum speeds to obtain this balance. It is represented by an area on the chart between the lowest points on a total-*cost*-per-piece curve and a total-*time*-per-piece curve.

How can *you* employ Hi-E to get BETTER PROFITS THROUGH BETTER TOOLING? Talk it over with your Carboloy representative. He'll be glad to go into detail on Hi-E machining as it applies to *your* operation. Or write directly for your free copy of our detailed Hi-E booklet.

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CARBOLOY® CEMENTED CARBIDES
MAN-MADE DIAMONDS • MAGNETIC MATERIALS
THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

Swingline #101 Staple Gun

The Tool of a 1000 Uses.

FRONT and BACK views of #101 Staple Gun base.

Swingline INC

Manufacturers of staplers, staples & office specialties

■ Swingline, Incorporated, represents another example of the reliance successful manufacturers place upon U. S. Press Room Equipment.

In the manufacture of their "Swingline No. 101 Staple Gun" Swingline utilizes the U. S. team of "Cradle to Straightener to Slide Feed" — a perfectly matched combination.

Swingline, in the production of their 101 Staple Gun, fabricates the 101 base from .062" coil stock, 1.468" wide. Stock is unwound from a model ACC-1-9C U. S. Multi-Roll Cradle. From the Cradle, stock leads into a model SS-27 U. S. Plain Stock Straightener which removes coil set. The stock is drawn through the Plain Straightener by a model SF-68A U. S. Slide Feed and accurately fed to the press with a feed stroke of 5⅜", at a rate up to 4000 per hour. This particular U. S. Slide Feed has a maximum stock width capacity of 6" and a maximum feed length adjustable up to 8".

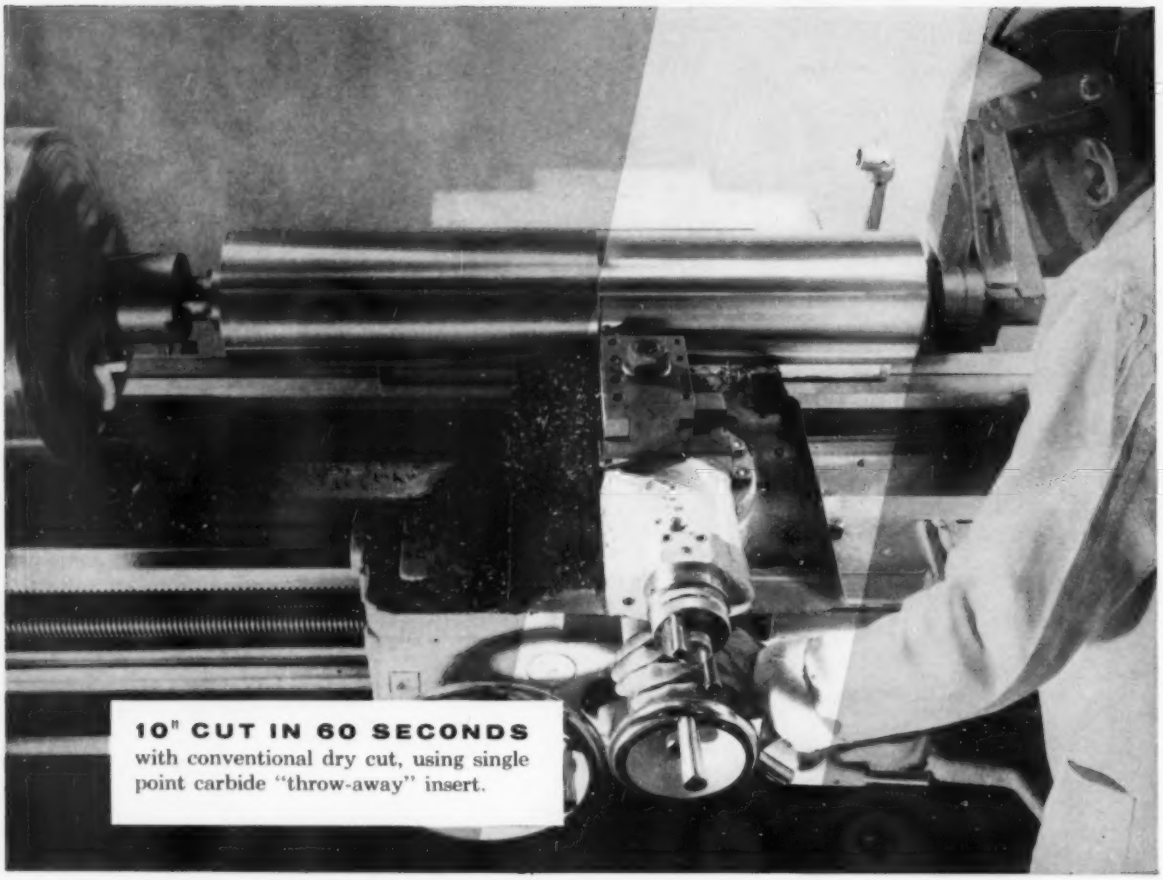
As it has for Swingline and many other manufacturers, U. S. Press Room Equipment can help you to produce a fine product, economically. If yours is a press room production operation, get the complete story about U. S. Press Room Equipment by sending for Bulletin No. 85T.

TURNS TO U.S. PRESS ROOM EQUIPMENT

U. S. TOOL COMPANY, INC. AMPERE (East Orange) NEW JERSEY

U. S. Multi-Slides® • U. S. Multi-Millers® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories

US MULTI-SLIDE



A new cutting fluid that

with any single-point

Shell's experience in the last 3 years proves that Shell Dromus Oil E can give production increases of at least 25% with comparable cost savings.

Incredible as this may seem, Dromus® Oil E alone accounts for these considerable production increases! And here's how simply Dromus E does it: Use Dromus Oil E (diluted with 20 parts water) at the correct cutting speed. Then, increase the feed rate by one-third and operate as before. You can get a 25% production increase . . . optimum conditions may show as high as 40% improvement!

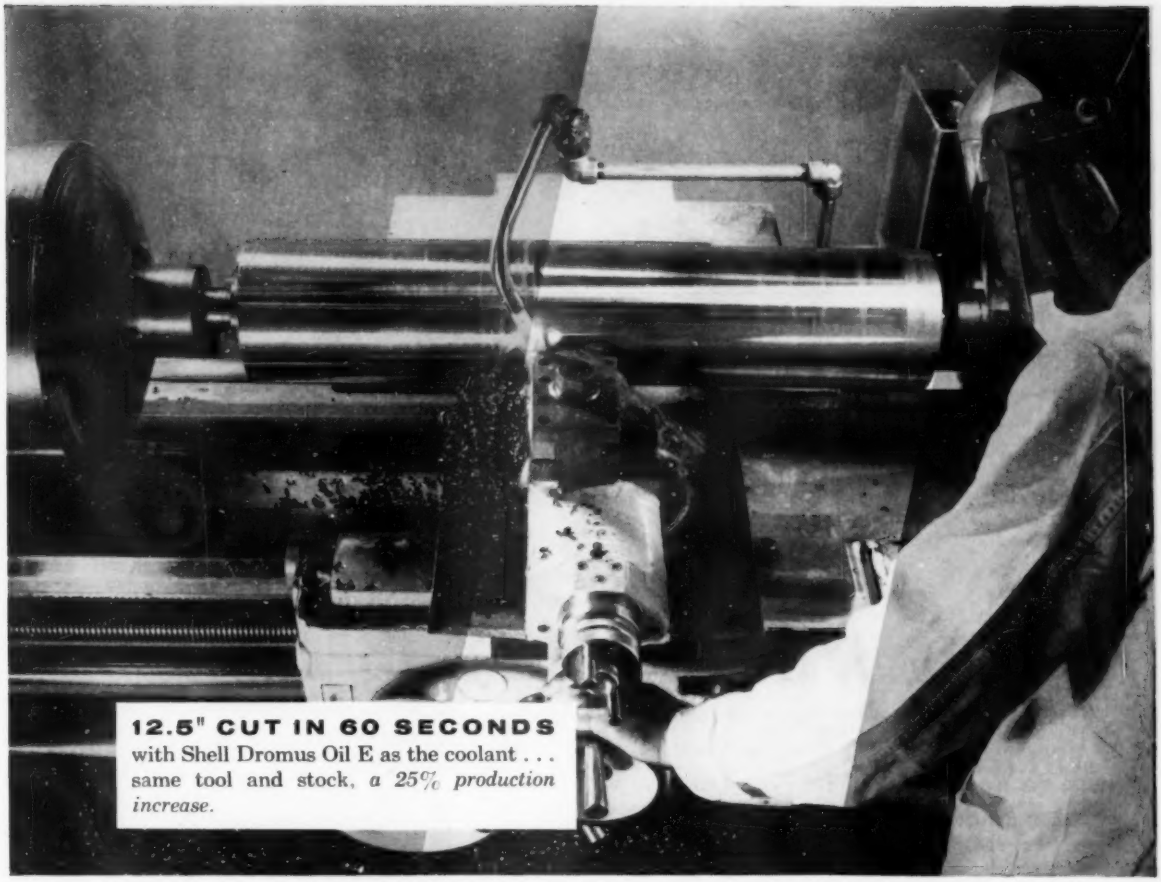
Applies to wet or dry cutting. Regardless of whether you're now cutting dry, or with emulsions or heavy-duty oils, this simple increase of feed applies.

Applies to all milling, turret and automatic lathe set-ups. This is an across-the-board production improvement. If the machine can stand the extra 25% feed, the rule applies to all milling and turning jobs!

Applies to set-ups as they are . . . no changes required. There isn't a single thing that has to be changed or adjusted . . . just the feed and provision for keeping the work wet with Dromus E.

Shell Dromus Oil E offers these many other outstanding benefits too!

1. Greater worker safety—chips are cool.
2. No fire hazard—Dromus E is nonflammable even after water evaporation.
3. Closer dimensional tolerances can be obtained—less heating of the work piece occurs.
4. Brighter surface finish is obtained.
5. Excellent protection against rust.



permits 25% greater feed
(AT FULL SURFACE SPEED)

carbide "throw-away" insert

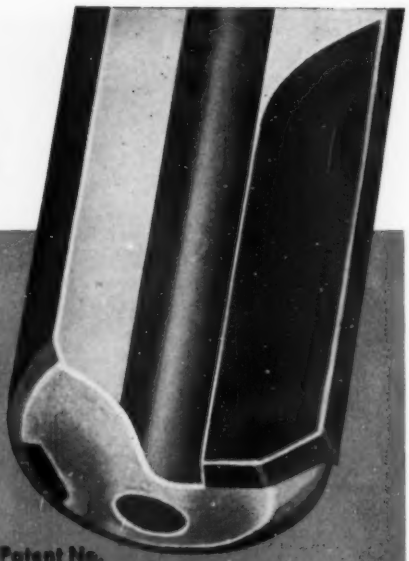
Dromus Oil E is one of those products that comes up once in a generation. Rather than attempt to offer proof after proof of what this announcement offers, we simply invite you to let the Shell Industrial Products Representative show you what Dromus Oil E can do in *your* plant! Please write Shell Oil Company, 50 West 50th Street, New York 20, New York, or 100 Bush Street, San Francisco 6, California. In Canada: Shell Oil Company of Canada, Limited, 505 University Avenue, Toronto 2, Ontario.

SHELL DROMUS OIL E

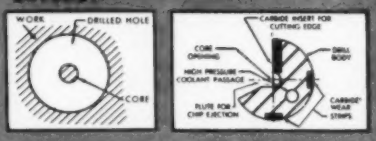
THE NEW COOLANT FOR METALWORKING

SHELL

ST



Patent No. 2418021



ST SUPERIOR TECHNICAL SKILLS

At STANDARD that means:
DESIGN and ENGINEERING Know how...
TESTED, and PROVEN by EXPERIENCE...
with the IMAGINATION to solve tomorrow's
METALWORKING PROBLEMS...TODAY!

Superior Techniques

. . . Using STANDARD'S TARGET Gun Drill it is now possible to drill deep or shallow holes with extreme accuracy . . alignment . . and high surface finish.

STANDARD'S Superior Technical Skills DEVELOPED IT! Utilizing the core principle, thrust requirements were reduced, minimizing tendency of drill to run.

Detachable design feature of carbide heads (7/16th or larger): allows easy replacement when necessary. Less machine down time.

Contact your Authorized Distributor for full details on this example of STANDARD'S Superior Tooling.

TARGET gun drill features:

- Eliminates zero surface speed at center.
- Extremely rigid shank keeps drill straight.
- Accurate diameters and alignment will often eliminate secondary reaming operations.

STANDARD'S PERFECTION...*Quality...Dependability...Since 1881!*

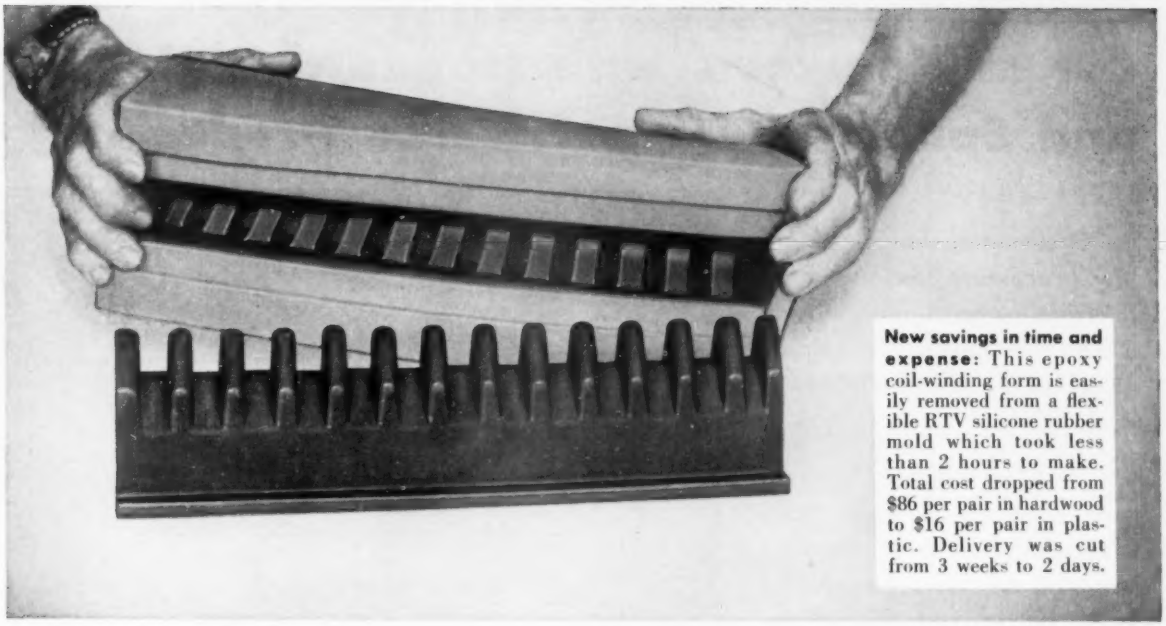
The STANDARD Distributor in Your Area Stocks a Complete Line of High Production Rotary Metal Cutting Tools

The STANDARD Quality Line • TWIST DRILLS • REAMERS • TAPS • DIES • MILLING CUTTERS • END MILLS • COUNTERBORES • CARBIDE TOOLS • GAGES • HOBS

STANDARD TOOL CO.

3950 CHESTER AVENUE CLEVELAND 14, OHIO

BRANCH OFFICES IN: NEW YORK • DETROIT • CHICAGO • DALLAS • LOS ANGELES • SAN FRANCISCO

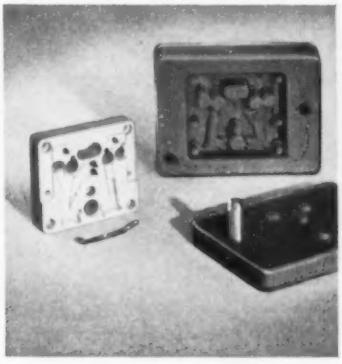


New savings in time and expense: This epoxy coil-winding form is easily removed from a flexible RTV silicone rubber mold which took less than 2 hours to make. Total cost dropped from $86 per pair in hardwood to $16 per pair in plastic. Delivery was cut from 3 weeks to 2 days.

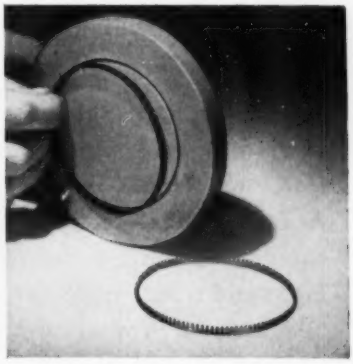
General Electric RTV silicone rubber opens up new fields in tooling and model making

Flexible, needs no parting agent, low shrinkage, duplicates glossy surfaces and fine detail

High-quality prototypes: RTV (room temperature vulcanizing) silicone rubber accurately reproduces surface finish and fine detail. This prototype control knob and other more complicated parts are easily removed from molds without using parting agents. Shrinkage less than 0.2%.



Precision, low-cost tooling: Previously machined from plastic laminate at a cost of $175 each, this fixture is now produced in a two-piece RTV mold at a saving of over $150 per part!



Ideal for casting fragile parts: 20 epoxy duplicates of this fragile actuator ring (.030" thick) were produced in this RTV mold. Even broken machine parts can be reassembled and used as a master to mold new parts.

For application data on RTV silicone rubber write General Electric Company, Silicone Products Dept., Section H1659, Waterford, New York.

GENERAL ELECTRIC

Silicone Products Dept., Waterford, N. Y.

Cut milling costs with standard Rigidmils* and Sundstrand "Engineered Production"

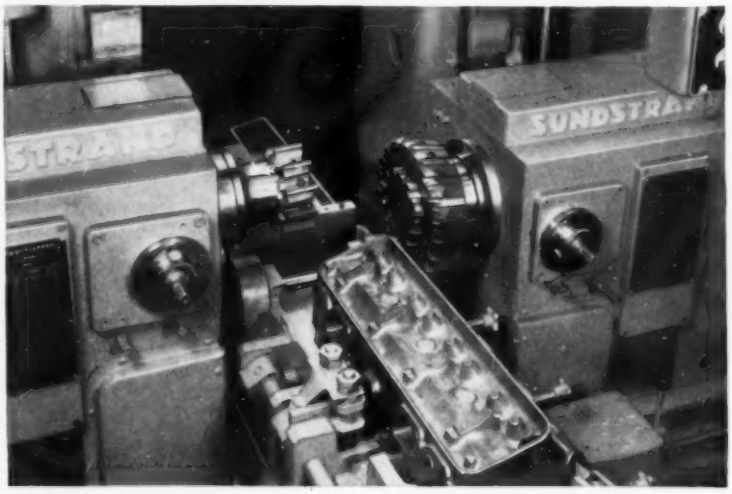
Determining the most profitable processing method, then selecting the machine to suit this method — that's Sundstrand "Engineered Production" at work.

To offer full benefit of the most profitable method, Sundstrand builds a wide range of standard machines as well as semi-standard and special machinery. From Sundstrand's extremely wide choice in table sizes, strokes, spindle speeds, horsepowers, controls and basic elements, you can get a standard machine with customized features for your particular job — yet one that can be readily converted to other jobs.

Sundstrand Rigidmils have been tooled in many ways to lower production milling costs. A few typical examples are shown. Countless plants using Sundstrand machines with "Engineered Production" methods and accessories have found them productive and economical. Call in a Sundstrand engineer to assist you with your milling problems. There is no obligation for this service.

Triplex Rigidmil

Two opposed side pads and one top pad are milled simultaneously on differential carrier parts with this triplex type Rigidmil. Vertical adjustment of side heads, endwise adjustment of spindles, and easily adjusted table feed stroke provide machine flexibility for future change in part sizes.



Duplex Rigidmil

Ten locating and transfer pads on opposite sides of cast iron cylinder heads are milled simultaneously, using carbide cutters. Output is approximately 28 parts per hour.

*Milling Machines

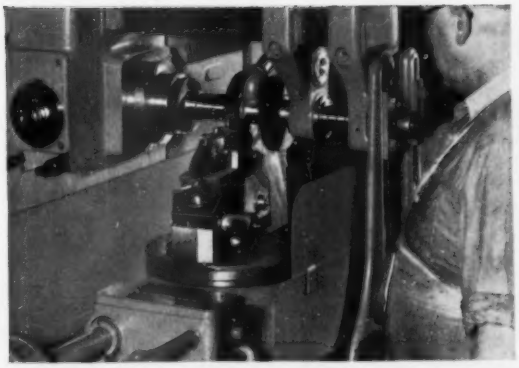
Learn more about the application of Sundstrand "Engineered Production" to the solution of your milling problems by writing today for Bulletin 708.

"Engineered Production" Service

SUNDSTRAND

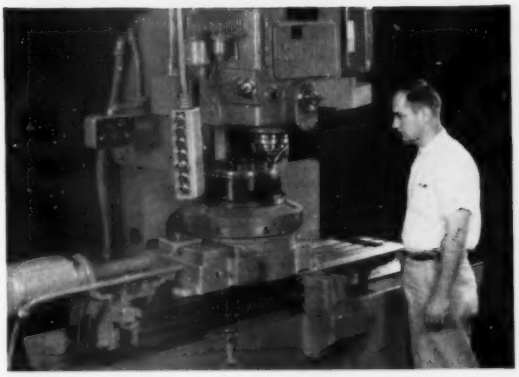
Simplex Rigidmil

Straddle milling both sides of stainless steel fuel nozzle, one at 140° and the other at 166°, and mounting work in dual fixture on an automatic index base boosted production materially. One side of the fixture is unloaded and reloaded while cuts are taken at the other side to make loading time free.



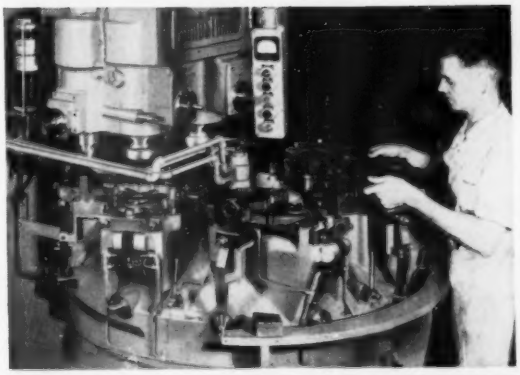
Vertical Rigidmil

Machining time was reduced 82% in milling 28 scallops on the periphery of a steel housing, when put on this standard vertical Rigidmil with a standard automatic index base attachment. Cycle is completely automatic including indexing. Operator only loads and unloads fixture.



Rotary Milling

This Rigidmil with rotary table makes possible a continuous milling cycle. Loading and unloading time is eliminated—operator loads and unloads while cuts are in progress. Machine shown has multiple spindle head so that ruff and finish cuts can be made with one locating and clamping of the workpiece.



Tracer Equipped Rigidmil

This Sundstrand C-5 Rigidmil equipped for tracer milling lost no time in effecting major savings when put on the job machining tool steel. Savings up to 75% over previous methods were made on the many different parts now run over this machine. Easy setup for various parts changes provided additional benefits.

SUNDSTRAND MACHINE TOOL

DIVISION OF SUNDSTRAND CORPORATION

BELVIDERE, ILLINOIS

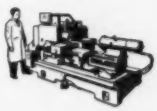
SUNDSTRAND

More facts about

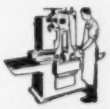
SUNDSTRAND

"Engineered Production"

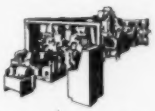
Literature listed under various machine types has more details. Write Sundstrand for your copy today.



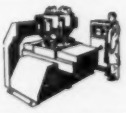
Automatic and Tracer Lathes
Bulletin A-108



Engineered Milling Production
Bulletin B-108



Examples of Transfer Machines—Bulletin C-108

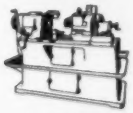


Multiple-spindle Drilling Machines—Bulletin D-108

Internal and Rotary Surface Grinders—Bulletin E-108

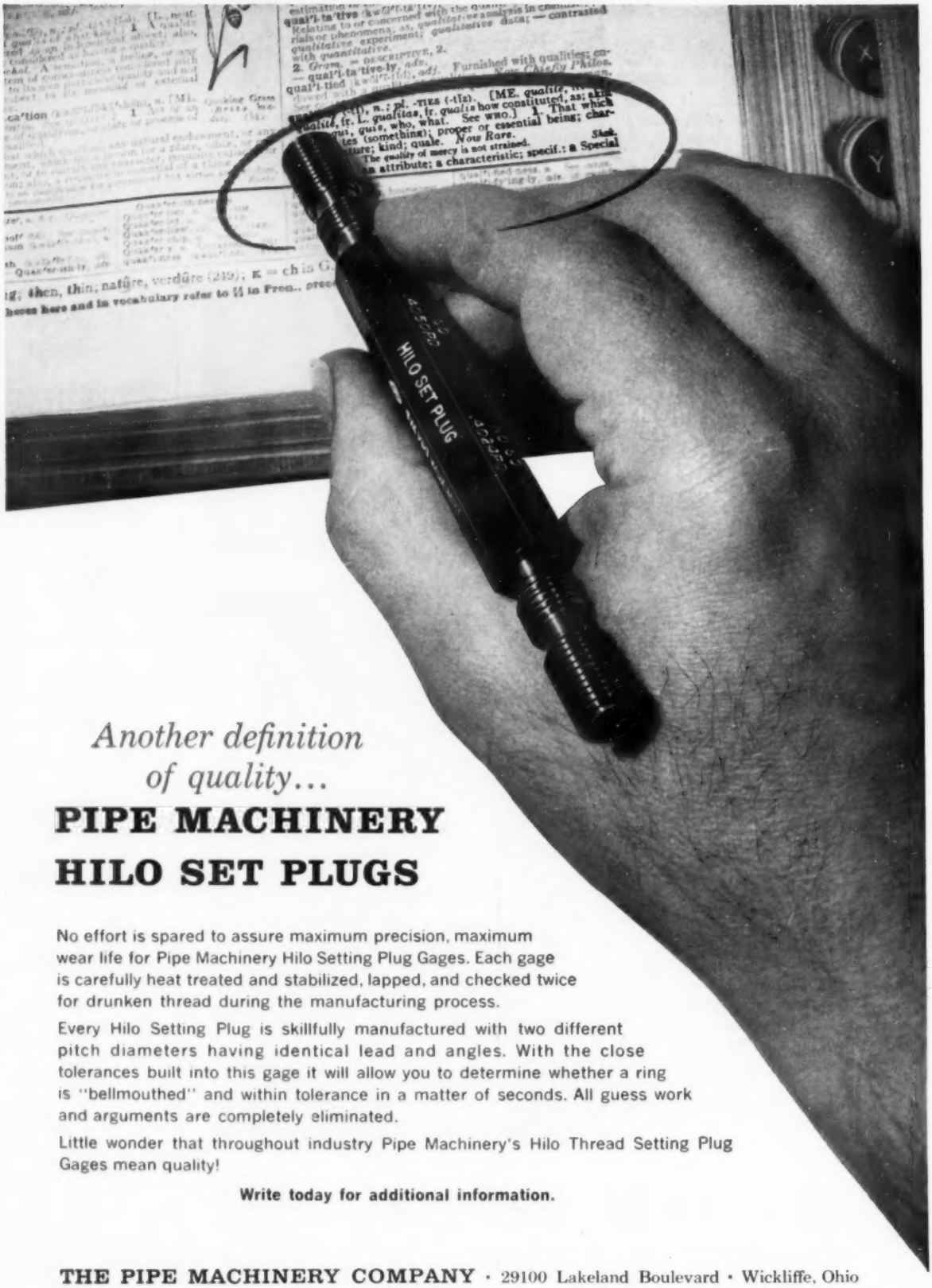
Broaching Tools
Bulletin F-108

Practical Broaching Methods
Bulletin F-108



Thread Milling
Bulletin G-108

USE READER SERVICE CARD, CIRCLE 26



Another definition of quality...

PIPE MACHINERY HILO SET PLUGS

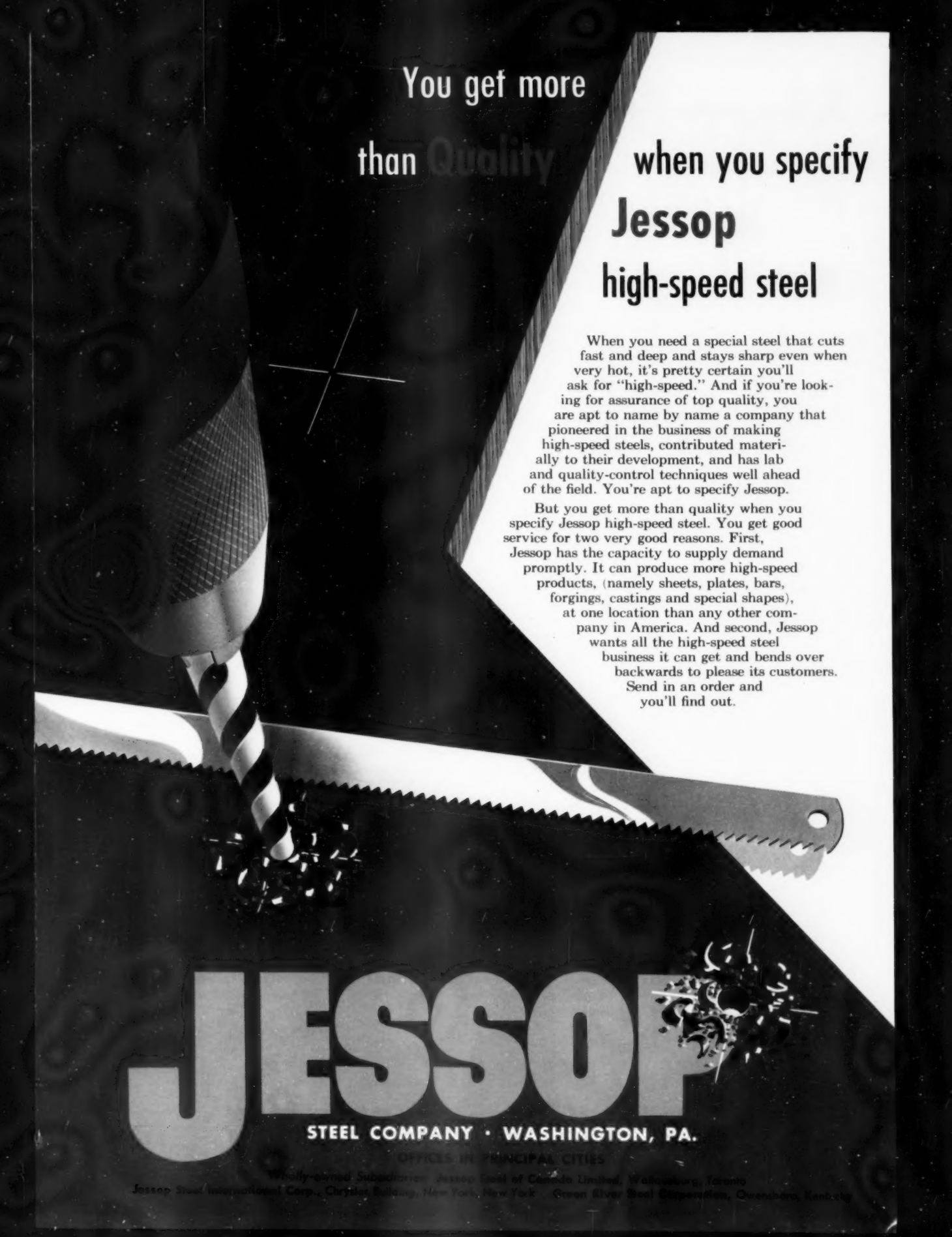
No effort is spared to assure maximum precision, maximum wear life for Pipe Machinery Hilo Setting Plug Gages. Each gage is carefully heat treated and stabilized, lapped, and checked twice for drunken thread during the manufacturing process.

Every Hilo Setting Plug is skillfully manufactured with two different pitch diameters having identical lead and angles. With the close tolerances built into this gage it will allow you to determine whether a ring is "bellmouthed" and within tolerance in a matter of seconds. All guess work and arguments are completely eliminated.

Little wonder that throughout industry Pipe Machinery's Hilo Thread Setting Plug Gages mean quality!

Write today for additional information.

THE PIPE MACHINERY COMPANY · 29100 Lakeland Boulevard · Wickliffe, Ohio


You get more
than Quality
when you specify
Jessop
high-speed steel
When you need a special steel that cuts fast and deep and stays sharp even when very hot, it's pretty certain you'll ask for "high-speed." And if you're looking for assurance of top quality, you are apt to name by name a company that pioneered in the business of making high-speed steels, contributed materially to their development, and has lab and quality-control techniques well ahead of the field. You're apt to specify Jessop.
But you get more than quality when you specify Jessop high-speed steel. You get good service for two very good reasons. First, Jessop has the capacity to supply demand promptly. It can produce more high-speed products, (namely sheets, plates, bars, forgings, castings and special shapes), at one location than any other company in America. And second, Jessop wants all the high-speed steel business it can get and bends over backwards to please its customers. Send in an order and you'll find out.
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STEEL COMPANY · WASHINGTON, PA.
OFFICES IN PRINCIPAL CITIES
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More Milling Possible...
Milling More Profitable
with FUTURMILL

and a handful of carbide blades

Futurmill's indexable milling cutters converted so many *slow and expensive* machining methods to *fast, low cost* operations, that they established the value of "indexable tooling" . . . recognized as one of today's most important contributions to metalworking progress.

1. Lower cost metal removal

Futurmill takes the burden out of milling with inexpensive indexable carbide blades. No need to remove the cutter from the machine . . . no more cutter grinding and no more delays and lost production time. Index a Futurmill quickly and accurately, right on the machine. Eight times per blade with negative rake cutters and four times with positive. Futurmill's precision ground blades get the finest finish obtainable and more metal removed per cutting edge.

2. Plenty of muscle for any job

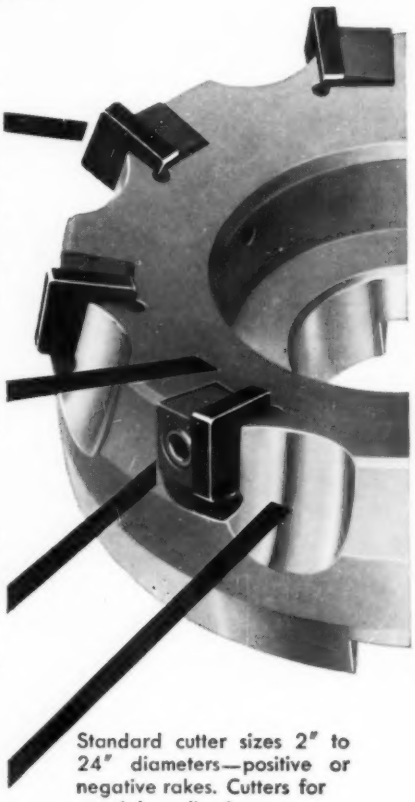
The cutter body is a solid one piece construction of heat treated alloy steel . . . not only the most rigid cutter built . . . but precision built.

3. Protection for the cutter body

The case hardened wedges behind the blades absorb the damage in case of an accident and save the cutter body . . . cutting down expense and lost production time for cutter repair or replacement . . . reducing inventory investment. With just a few extra wedges you're back in production.

4. Unobstructed chip clearance

Huge chip pockets in front of the blades direct the chips ***out and away*** from the cut—critical on steel applications and on deep cuts.



Standard cutter sizes 2″ to 24″ diameters—positive or negative rakes. Cutters for special applications.

FUTURMILL, INC.

6360 Highland Road • Pontiac, Michigan

In Canada: P.O. Box 95, Dundas, Ontario

A LAPMASTER CAN MEAN BIG SAVINGS...A BETTER PRODUCT

here are more examples of how:

HIGH PRODUCTION RUNS or small lots—both turned out with *consistent* accuracy on a Lapmaster. Day-in-day-out production rates range from a few pieces to thousands per day.

FLATNESS OF .0000116" or less with a micro-inch finish of 2 to 3 RMS is everyday work for a Lapmaster. Uniform accuracy maintained piece-after-piece because conditioning rings automatically keep lap plate flat.

4920 LB. PARTS can be handled—as well as small ⅛" dia. pieces. This 84" dia. weldment for a radar tracking antenna was lapped to a flatness and parallelity within ± .00005" on a Lapmaster Model 84.

TALL and SMALL PARTS AT THE SAME TIME. No expensive fixturing required... in most Lapmaster applications only inexpensive masonite or micarta work holders are necessary. Eliminates danger of stresses and warpage usually caused by clamping during grinding.

EXTERNAL and INTERNAL LAPPING IN ONE OPERATION. Versatility of the Lapmaster is demonstrated in this lapping operation on R. R. air brake parts. Reciprocating mechanism runs small lapping block in and out of work while other parts are being lapped on plate.

SHAPE OR FORM NO PROBLEM. Special lap plate and work holder permit lapping of swing check valve. Other simple attachments and holding devices can be furnished to facilitate lapping of "hard-to-handle" or extremely large parts.

Lapmaster®

...THE MACHINE THAT PUT PRECISION LAPPING ON A PRODUCTION BASIS

WRITE FOR THE COMPLETE LAPMASTER STORY

Write for bulletins describing the Lapmaster line and chart on measuring flatness.

A product of

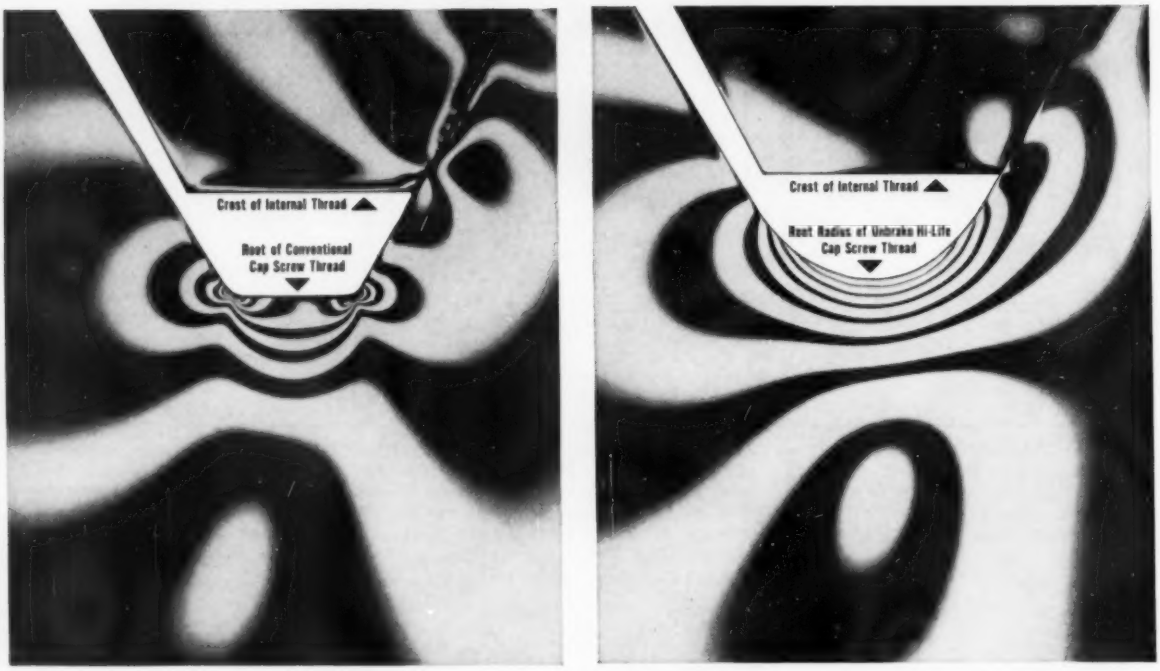
Crane Packing Company

6469 OAKTON STREET • MORTON GROVE, ILLINOIS (Chicago Suburb)

In Canada: Crane Packing Company, Ltd., Hamilton, Ont.

SPS RELIABILITY / *A dynamic standard of predictable performance*

The big change is in the threads


Crest of Internal Thread
Root of Conventional Cap Screw Thread
Crest of Internal Thread
Root Radius of Unbrako Hi-Life Cap Screw Thread

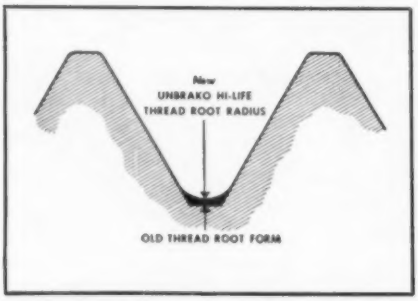
COMPARE THESE PHOTOELASTIC STUDIES

OLD THREAD ROOT FORM has sharp corners which cause high stress concentration and reduce fastener fatigue life.

NEW UNBRAKO HI-LIFE THREAD ROOT has large, smooth radius which distributes stresses, thereby increasing fastener fatigue life.

At no increase in cost, new UNBRAKO Hi-Life socket head cap screws offer

- **Up to 100% greater fatigue life**
- **Increased tensile strength capacity**
- **Additional life insurance for your product**



COMPARE THE THREAD ROOT FORMS in the drawing at left. The bottom line indicates the old thread root form. Note the flat roots with sharp corners where cracks start. The top line indicates the new thread root form of UNBRAKO Hi-Life socket cap screws. Note the smooth, flowing curve that dissipates stresses. In addition to increasing fastener fatigue life up to 100%, the larger body cross section provides greater tensile strength, permitting the application of greater preloads.

And there is no waiting for the bonuses you get from new UNBRAKO Hi-Life socket cap screws. SPS distributors are now stocking these new precision fasteners with the improved thread root form, evolved through research on high-strength fasteners. Fatigue life of improved UNBRAKOS can increase the reliability of your product.

For more information, ask your nearest authorized SPS industrial distributor for a copy of Bulletin 2577. Or write SPS—manufacturer of precision threaded industrial fasteners and allied products in many metals, including titanium.

INDUSTRIAL FASTENER Division **SPS**

JENKINTOWN 37, PENNSYLVANIA

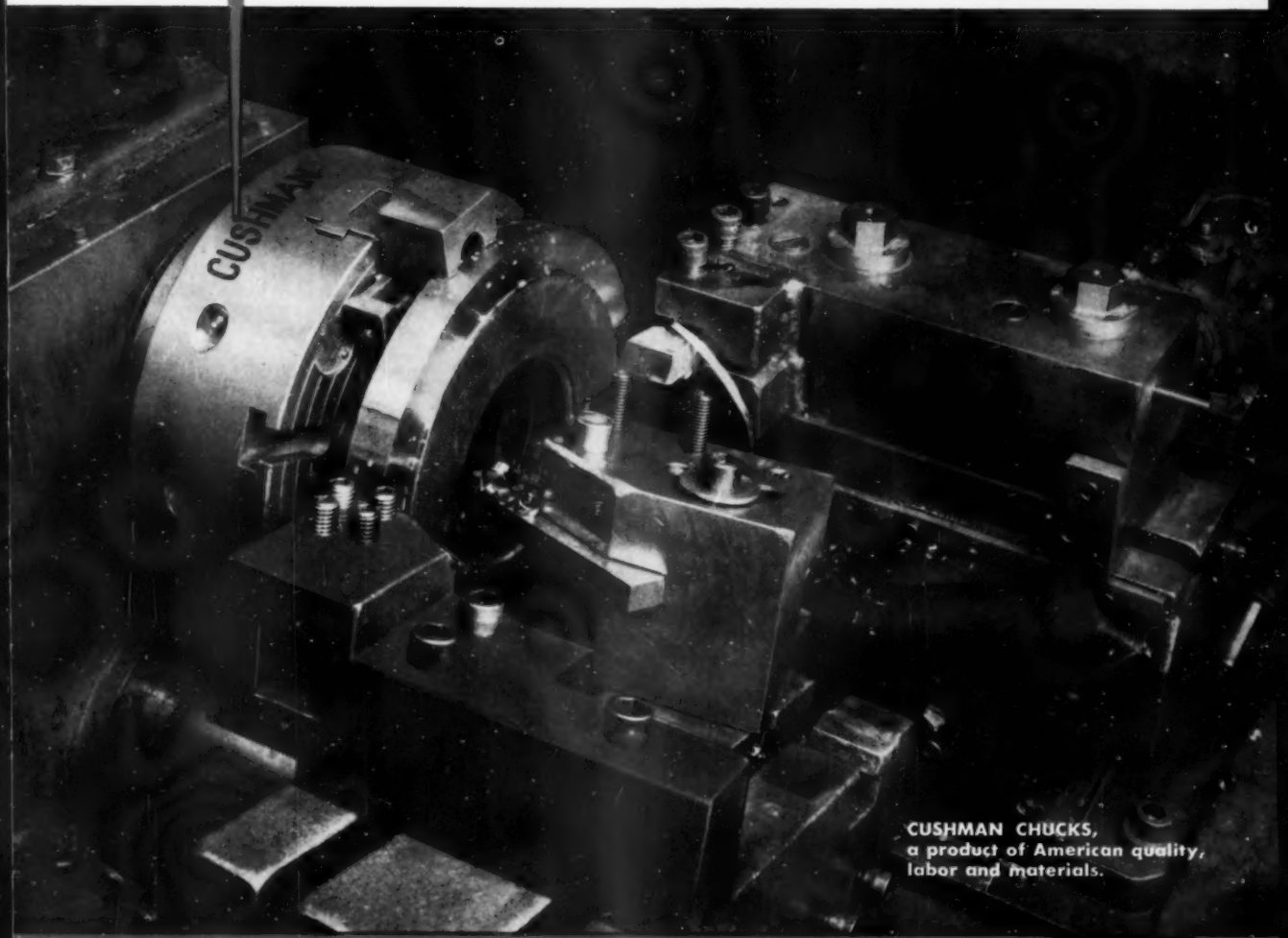
Beat production quotas and costs with:

Cushman air operated

CHUCKING EQUIPMENT

Cushman, the leading manufacturer of air operated chucking equipment, has designed and built a complete line of air operated chucks, cylinders and accessory equipment engineered to meet modern machine tool requirements of heavier feeds at higher speeds, maintain repetitive precision accuracy and positive gripping with truly fast workpiece chucking and unchucking.

Write today for your copy of Bulletin PO-65D and see how you, too, can effectively beat production quotas and lower machining costs by using efficient, economical Cushman Air Operated Chucking Equipment.



CUSHMAN CHUCKS,
a product of American quality, labor and materials.

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FIRST IN TOOL ROOM LABORATORY AND DEVELOPMENT WORK

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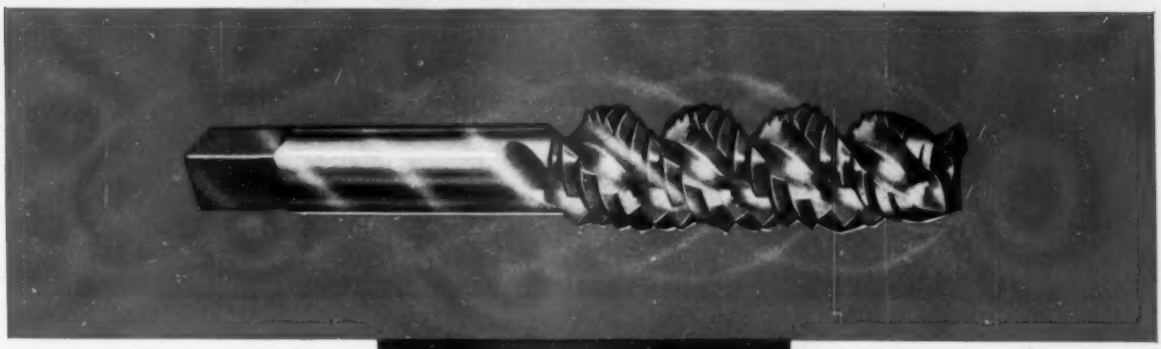
PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE



TURBO-CUT

the tap that's changing the meaning of "high production"

The reports we're getting from our field men on Turbo-Cut Tap performance are self-explanatory.

Here's a sample from one day's mail:

"This tap was run on an aluminum carburetor part and started to run undersize after 32,160 holes."

"We currently have a 3/8-24 Turbo-Cut that is still going after 18 shifts and over 43,000 holes."

"A #10-24 Turbo-Cut plug tap ran 18,200 holes on a zinc die cast job."

Threadwell's Turbo-Cut is piling up records like these daily. Every plant interested in increased production should take a look at the tap that really means "high production". See your threadwell Distributor now for details.

Only Threadwell makes the genuine Turbo-Cut.

Threadwell
MAKES THE BEST PRODUCT BETTER

INDUSTRIAL DISTRIBUTORS
THE RIGHT HAND OF PRODUCTION

THREADWELL TAP & DIE CO.
GREENFIELD, MASSACHUSETTS

Stocking Warehouses: New York — Cleveland
Detroit — Los Angeles — Greenfield, Mass.

USE READER SERVICE CARD, CIRCLE 34

When you see uniformity, remember . . .

With Card spiral pointed taps you get uniformity

Your production's consistent ...because Card taps are uniform

. . . And they're always readily available to meet your production schedules. To this end, Card Division maintains a network of warehouses across the country. Inter-connected by teletype, these strategically located supply centers give your Card Distributor fast, efficient service. He's always ready for your jobs. You get the exact type of Card tap you need . . . in any quantity . . . at any time. Your Card technical man has complete details on Card taps, dies, and gages. S. W. CARD DIVISION, Mansfield, Mass.

Card Warehouses: Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York, San Francisco.

The CARD Quality

CARD

DIVISION OF UNION TWIST DRILL COMPANY

— Serving you through the best distributors from Coast to Coast

USE READER SERVICE CARD. CIRCLE 35

If you use cutters as much as steel mills use ore . . .

Ordering Union cutters will cut your production time and costs

The more you use cutters the more you need Union

In addition to Union's full line of standard milling cutters, Union is prepared to lay out and design cutters singly or in gangs, for all your milling operations. In addition, Union technical men are showing plants throughout the country how production time and costs can be cut with solid milling and gear cutters, inserted blade cutters, drills, end mills, reamers, hobs and carbide tools. **Available nationally through Union Distributors** and stocked in Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York City and San Francisco.

UTD

UNION

TWIST DRILL COMPANY, Athol, Massachusetts

S. W. CARD DIVISION, Mansfield, Mass.; BUTTERFIELD DIVISION, Derby Line, Vt.

USE READER SERVICE CARD, CIRCLE 36

WESTERN UNION
TELEGRAM
TO ALL DIEMAKERS:
TO ALL DIE USERS:
BANKO PATENTS COVERING MECHANICAL HOLDING
OR INTERLOCKING SEGMENTS IN CARBIDE DIES NOW PURCHASED
AND RELEASED TO THE PUBLIC.
CARMET DIVISION, ALLEGHENY LUDLUM STEEL CORPORATION

CARMET®

again serves the Die Industry

Making these Banko patents available, by dedication, for free and public use is another step in Carmet's policy of serving makers and users of carbide dies.

No one appreciates the problems of the die industry more than Carmet, the pioneer supplier and developer of carbide metal used in dies.

Carmet's precision preform methods result in cost-cutting advantages. Practically any shape or size of blank is accurately formed, requiring only a minimum amount of grinding to final dimensions.

All of Carmet's vast production and research facilities are at the service of all die makers. Let our die specialists help you on your problems.

Write to *Carmet Division, Allegheny Ludlum Steel Corporation, Ferndale, Detroit 20, Michigan.*

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ALLEGHENY LUDLUM STEEL CORPORATION

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BATH *Tap'n Gage* TIMES

A series of technical discussions that will be helpful in getting better results from tapping and gaging operations

Vol. 1 No. 10

Subject: Common Types of Standard Taps:

Taps are available to the trade in many sizes and styles as stock items. It is really *customer demand* that determines what kind of taps are generally regarded and listed as STANDARD TAPS. These taps are readily available and are priced economically because of optimum manufacturing quantities. While most tap manufacturers make STANDARD TAPS to the same dimensions, individual company refinements in design and processing are such that STANDARDS made by different manufacturers vary just as much as specials.

STANDARD HAND TAPS

Although still known as hand taps, most of these taps are used today in machines on production. They are available in the common sizes from ¼-20NC through 1½-12NF. Usually they have four flutes, but in some sizes two, three and six are popular. These are the "work horse" or general purpose taps. They are also supplied for specific materials when ordered.

STANDARD MACHINE SCREW TAPS

These taps are the common sizes below ¼" and begin with 0-80NF which has a basic nominal size of .060, increasing by increments of .013 or multiples through 14-24NS, with .242 as a basic nominal size. These are the "work horse" or general purpose taps and are available in a number of flute options. They are also supplied for specific materials when ordered.

SPIRAL POINTED TAPS

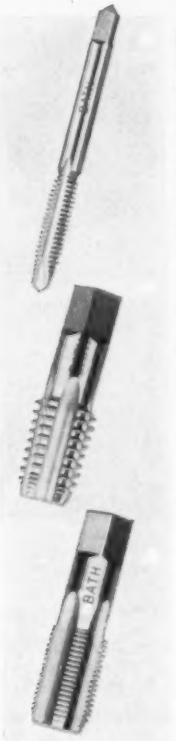
The spiral pointed tap gets its name from the angular grind at the front of the flute. This feature forces the chips ahead of the tap which makes the design most suitable for through holes or holes where ample space is provided for chip collection. They are available in the common machine screw sizes from 0-80NF through 14-24NS and in the common hand tap sizes from ¼-20NC through ½-20NF.

SHORT FLUTE SPIRAL POINTED TAPS

These rugged taps are designed for tapping punched holes, sheet metal and other thin sections of not more than one diameter or the length of the spiral point. They are available in the common machine screw sizes from 3-48NC through 12-28NF and in the common hand tap sizes from ¼-20NC through ½-20NF.

HELICAL FLUTED TAPS

These taps are distinguished by the right hand helical flute feature designed to eject chips from the tapped hole. They are most effective in material that produces long, stringy, curling chips when tapped. They often are superior to straight fluted taps in holes with keyways, slots or gaps. They are available in the common machine screw sizes from 3-48NC through 12-28NF and in the common hand tap sizes from ¼-20NC through ½-20NF.



OVERSIZE MACHINE SCREW SIZES

These taps are designed for tapping die castings, plastics, bakelite and other abrasive materials. Being .002 larger than regular taps, they allow for plating and heat treating and produce large holes for ease of assembly. They are available in 6-32NC, 8-32NC, 10-24NC and 10-32NF with regular flutes and spiral point.

TAPER PIPE TAPS

These taps are generally used for pipe fittings and couplings although there are some other applications. They are available in sizes 1/16-27 through 2-11½ regular and interrupted thread with the following pipe thread forms:

NPT	American Standard Pipe Form
NPTF	American Standard Dryseal Pipe Form
ANPT	Aeronautical Pipe Threads

STRAIGHT PIPE TAPS

These taps are used for tapping couplings, lock nuts and other straight pipe fittings. They are available in sizes 1/8-27 through 1-11½ with the following pipe thread forms:

NPS, NPSC, NPSM — American Standard Pipe Form

NPSF through ½" — American Standard Dryseal Pipe Form

For complete tap information fill in and mail coupon TODAY for your BATH catalog.

John Bath & Co., Inc., 28 Mann Street, Worcester, Mass.

Please send Bath catalog to:

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• Cylindrical and Thread Gages • Ground Thread Taps • Internal Micrometers John BATH & Co., Inc.

28 Mann Street, Worcester, Mass.

NEW FROM FAIR STREET • HOME OF THE JIGMIL

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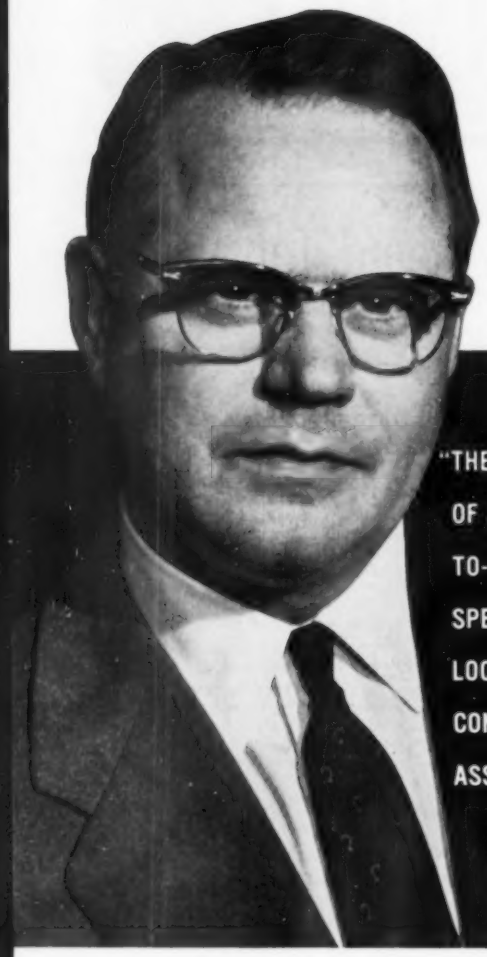
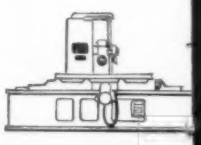
direct dial dimensioning system



"THE DIATROL SYSTEM OF AUTOMATIC POINT-TO-POINT POSITIONING SPEEDS UP SPINDLE LOCATION, SIMPLIFIES CONTROL AND ASSURES ACCURACY"

"Simply dial in the pre-selected coordinate dimensions, touch a button, the rest is automatic. The JIGMIL table and spindle head automatically position at the desired hole location in seconds. While the JIGMIL is machining, you can *pre-set* your next move. Developed by our own engineers, Diatrol adds to the inherent versatility and accuracy of the JIGMIL, further reducing human error as well as set-up and machine time. *Diatrol makes it possible to machine custom or small lot jobs at production rates.*"

C. R. DE VLIEG



DEVLIEG MACHINE COMPANY, FAIR STREET • ROYAL OAK, MICHIGAN

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for DeVlieg Spiramatic Jigmils

Simple! Accurate! Automatic! Diatrol is a transistorized electro-mechanical system, simple in design and simple to operate. All settings are made on direct reading dials; one dial for horizontal, the other for vertical dimensioning. Direct dialing of positive or negative dimensions is possible from any arbitrarily selected datum plane or zero point within the range of the system. Coordinate dimensions can be fed direct from the blue print, eliminating much of the mathematics formerly required for accurate jig boring. Measurement and positioning accuracies are controlled to one-ten-thousandth of an inch. Developed exclusively for the JIGMIL, Diatrol is now available for the complete range of JIGMIL precision boring and milling machines. For complete information, write or arrange a visit to Fair Street.

Rewarding revelations in precision await your visit to Fair Street

DeVlieg

SPIRAMATIC JIGMILS®

ACCURATE HOLES AND FLAT SURFACES IN PRECISE LOCATIONS

..... HOME OF THE JIGMIL

USE READER SERVICE CARD, CIRCLE 39

NEW!

CARRIERS

for 3-wire thread measuring

10 TIMES FASTER THAN HAND-HELD WIRES

Easiest, most practical way of measuring threads by 3-wire method. Makes thread measuring as easy as plain O.D. checking!

- LONGER WIRE LIFE — TROUBLE FREE!
- NO HAND CONTACT — NO CORROSION FROM PERSPIRATION
- NO WIRE BENDING OR LOSS
- USE FAMOUS VAN KEUREN WIRES
- MEASURE ALL STANDARD PITCHES
- FLOATING WIRES — CARRIERS CANNOT INTERFERE WITH POSITIONING
- EACH SET OF CARRIERS AND WIRES IN SEPARATE VIAL WITH FULL DATA
- ADAPTERS PERMIT USE OF "MIKE" CARRIERS ON MEASURING MACHINES

Use them for: CHECKING THREAD PLUG GAGE WEAR
IN-PROCESS INSPECTION
RECEIVING INSPECTION

FOR MICROMETERS — FOR MEASURING MACHINES

MICROMETER CARRIERS are made to fit Starrett Micrometers (.234 spindle and anvil diameter; anvil height .070" min.) and will measure the pitch diameter of American National and Unified 60° threads from #0 through ¼" diameter; all standard threads, 10 through 80 TPI. Sets, in deluxe mahogany case, contain 19 pairs of carriers and wires for the above range, plus micrometer and pair of measuring machine spindle adapters. May be ordered without micrometer and/or adapters.

MEASURING MACHINE CARRIERS are made to fit Pratt & Whitney Measuring Machines (.375 spindle and anvil diameter). Set covers all standard threads, #0 through 1" and 8 through 80 TPI.

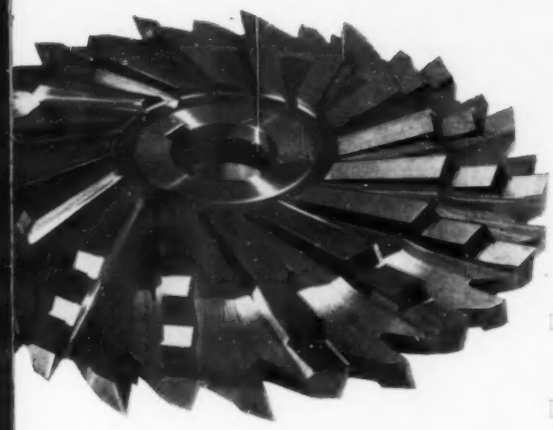
Ask the *Man-from-Standard* for demonstration or write for BULLETIN 59-2.

Patents applied for

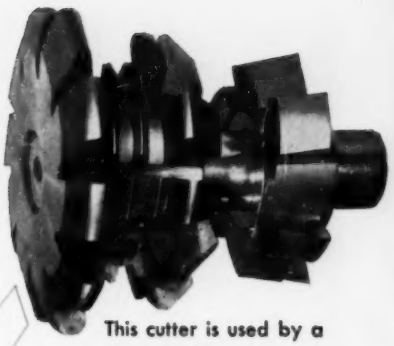
STANDARD GAGE COMPANY, INC.

SINCE 1925 • POUGHKEEPSIE, N.Y.

A COMPLETE LINE OF GAGES . . . INDICATING, FIXED AND ADJUSTABLE TYPES

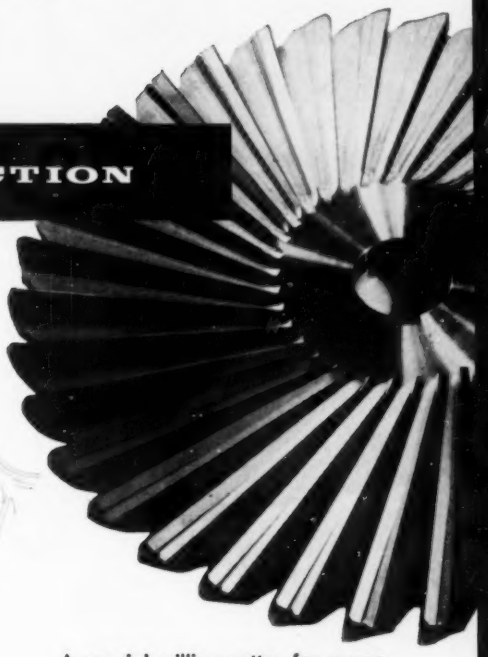


A special multiple-step milling cutter used by steam turbine manufacturer to cut stepped rotor slots for turbine blades.

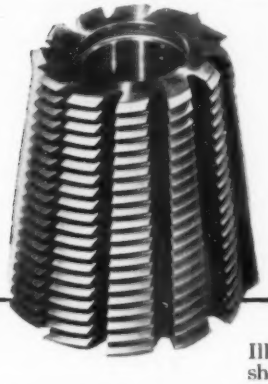


This cutter is used by a prominent saw manufacturer to form mill the profile in dado blade sets for the wood working industry.

HOW TO GET THE MOST OUT OF HIGH SPEED PRODUCTION MILLING MACHINES



This tapered multiple thread mill cuts threads in pipe joints used in oil well drilling operations.



A special milling cutter for sweep milling impellers used in air conditioning and jet engine sections.

Illinite® Special Milling Cutters, like those shown here, speed production and cut costs two ways:

(a) Illinois Tool applied metallurgy assures long, efficient tool life through proper material selection, forging and heat treatment *tailored to your specific application.*

(b) Illinois Tool engineering job-tailors your special milling cutters for maximum efficiency. ITW tool designers often combine several machining operations into a single cutter or gang, with consequent savings of considerable time per piece. Specially designed tools such as these also assure improved accuracy *since accuracy is designed into the tool,* and is not dependent upon several separate operations.

Why not get the most from *your* high speed production machines. Ask your Illinite distributor about job-tailored milling cutters today! Remember, he also carries a complete stock of standard cutters for prompt delivery.

Write today for this helpful new booklet on Metallurgy in Tool Design and Production.

ILLINOIS TOOL WORKS

TOOL & INSTRUMENT DIVISION

2501 N. KEELER AVENUE • CHICAGO 39, ILLINOIS

Your ILLINITE distributor is just a phone call away.

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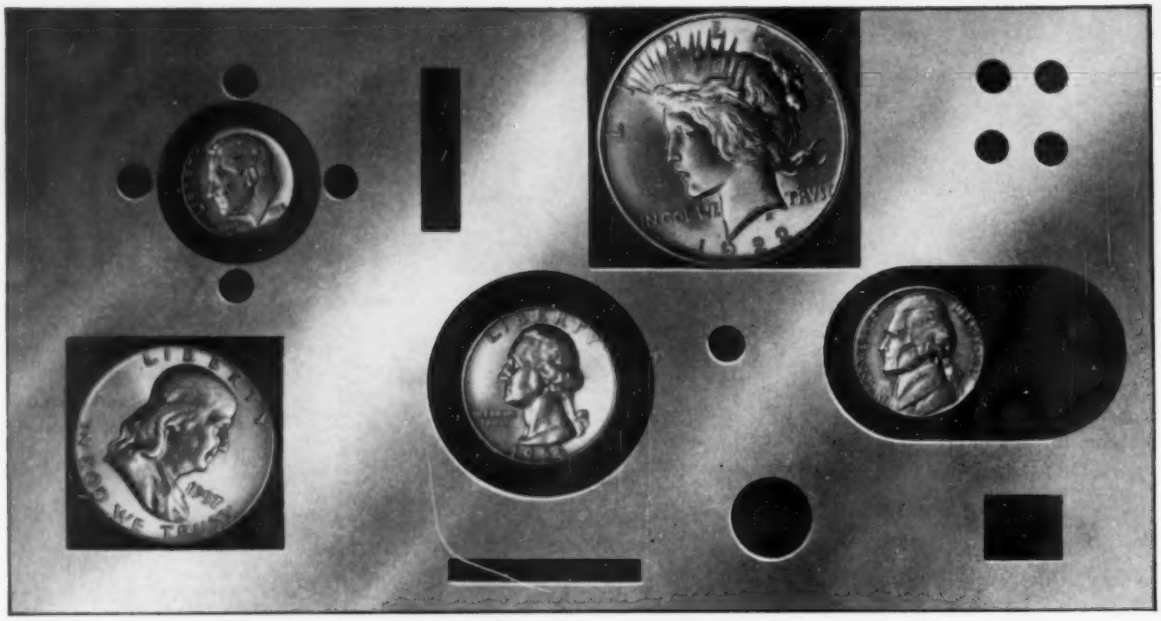


How Much Are You Paying for Holes?

Producing openings in low quantity work can be costly and time consuming, or it can be a simple, high speed operation —the difference is a Wiedemann Turret Punch Press.

Only a Wiedemann gives you:

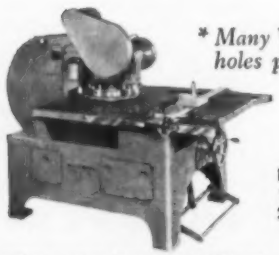
1. the speed of a punch press.
2. the immediate availability of a variety of punches and dies in a turret—no setup.
3. a quick setting, mechanical work positioning gauge—no layout.

Parts are produced as needed, and even extensive engineering changes can be made on-the-spot. Holes are produced for as little as a penny each* with standard tooling, and only one punch and die of a size is required. With direct savings of 60% to 90%, the press pays for itself in one to two years.

Take a closer look at the savings you can expect with the Wiedemann Method. Send drawings of your work for time study and write for Bulletin 301.

TYPICAL WORK PRODUCED ON WIEDEMANN TURRET PUNCH PRESSES

- Aircraft and missile components.
- Road building equipment and trucks: mixers, spreaders, shovels, cranes, etc.
- Electrical panels, switchgear, housings, cubicles and components.
- Electronic chassis: control, television, radar, computers, etc.
- Industrial refrigeration, laundry, baking, kitchen, food dispensers and similar equipment.
- Instrument mountings and panels.
- Air conditioning: housings, baffles, etc.
- Pre-production prototypes.
- Machinery: fabricated bases, side structures, conveyors, etc.



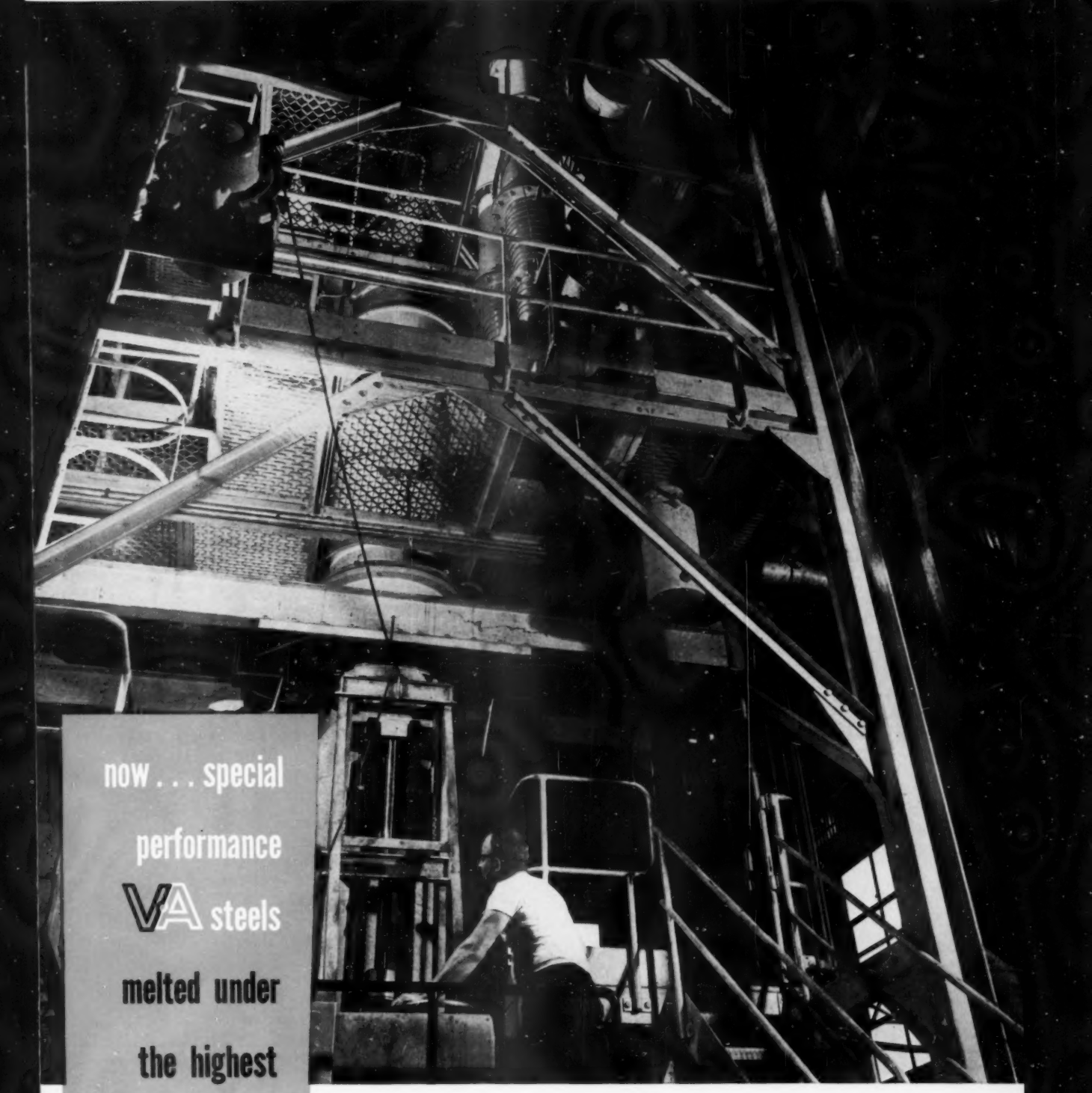
RA-41P Wiedemann
15-ton capacity
28" throat depth

Other models from 4 to 150 tons

** Many Wiedemann users are selling holes profitably at a penny apiece.*

WIEDEMANN MACHINE COMPANY
TURRET PUNCH PRESSES

DEPT. TE-10 • GULPH ROAD • KING OF PRUSSIA, PA.



now . . . special performance VA steels melted under the highest vacuum obtainable in the industry today

(under .3 microns pressure)

The steels from our unique consumable electrode (CVM) vacuum melting furnace open a new phase in the aircraft, missile, steam turbine and other fields where utmost steel cleanliness and lengthened fatigue life are vital to higher performance. We will be happy to prove to you where these CVM Steels, and those produced by our Induction Vacuum Melting processes, can do far more for your needs than their difference in cost would indicate. Write for new brochure.

VA **Vanadium-Alloys Steel Company**

LATROBE, PENNSYLVANIA

DIVISIONS: Anchor Drawn Steel Co. • Colonial Steel Co. • Metal Forming Corporation • Pittsburgh Tool Steel Wire Co.

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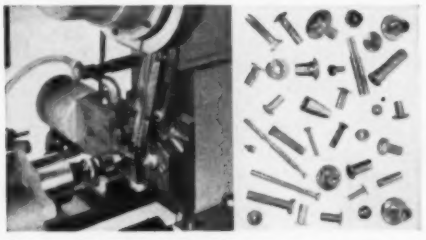
NOW AVAILABLE...

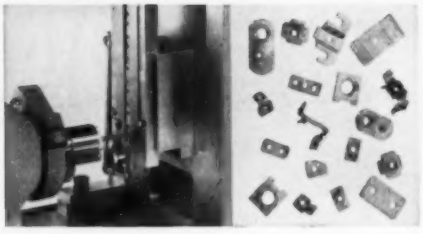
for automatic drilling, tapping or threading

Hand feed or hopper feed with or without air-operated clamp

NOW...drill rivets faster with minimum tooling costs



Drills 500-3600 per hour; hopper feed; air-operated clamping. Capacity #74 (.0225") to ⅜" in mild steel.



Taps 4000 per hour hand feed magazine. Capacity #0 to ⅜" fine pitch in mild steel.

A new horizontal version of the same operating principles long used in Snow vertical machines. Snow machines reduce changeover time, and cut tooling costs to a ridiculous minimum. On your next job, let us show you what the Snow method can do. Submit samples and prints.

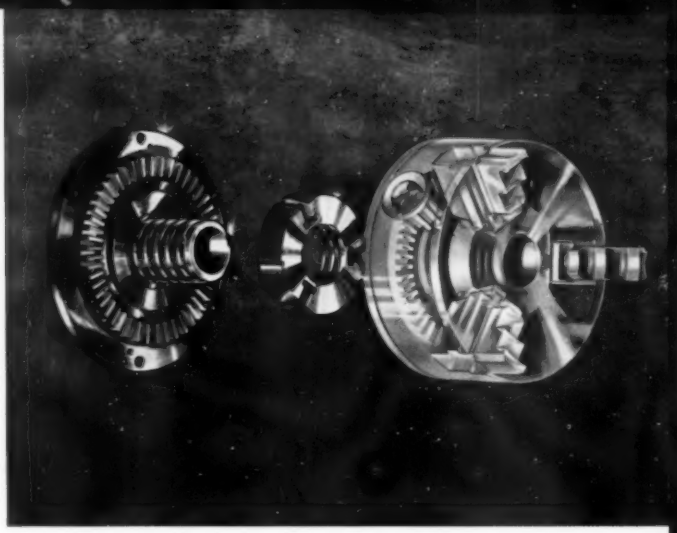
Snow Manufacturing Company, Dept. T, 435 Eastern Avenue, Bellwood, Illinois (Suburb of Chicago)

SNOW *master fixtures save dollars and days in tooling costs*

SKINNER ANNOUNCES

The first major chuck development in 50 years

- Accuracy—within .001 total indicator reading.
- Repeatability, without adjustment—within .0005 total indicator reading.
- Unequalled gripping power—
- No size limitation—



THE FIRST MAJOR CHUCK DEVELOPMENT IN FIFTY YEARS

Skinner engineers have developed a new chuck that combines all the desirable features of hand and power chucks. This unique chuck will handle almost any heavy-duty chucking or milling operation.

This major chuck development is a principle utilizing combination of pinion, gear plate, screw and wedge. The lug-type pinion is turned manually or by a power wrench. A pinion engages the gear plate causing the screw to move the wedge. The action of the screw on the wedge controls the chuck jaws. The force of the wedge on the jaws holds the work with tremendous power.

LOOK AT THESE CHUCK FEATURES—

Over Tightening Protection—Because the gripping force is so great a sheer pin is used to protect the work and the chuck operating parts in the event the chuck is over tightened. The sheer pin is easily replaced.

Operator Protection—Eccentric, fail-safe mechanism locks rotation if sheer pin should break.

Higher Speeds—Self-locking mechanism prevents chuck from opening under any load or centrifugal force conditions.

Center Hole—permits bar stock chucking.

Sealed Operating Mechanism—Chip plates plus top and bottom seals keep operating mechanism free of foreign matter with no problems when chuck is in horizontal position.

Lubrication Fittings—are provided for all operating mechanisms.

Heat Treated Parts—All wearing surfaces are suitably hardened for wear resistance and strength.

Jaws—Choice of types available: Serrated, tongue and groove, etc.

Sizes—10″, 12″, 14″, 15″, 18″, 21″, 24″, 28″, 32″, 36″, 40″, 50″, 60″ and above.

For more information about this radically new chuck write to us at the address below.

SKINNER CHUCKS®

THE CREST OF QUALITY

SKINNERCHUCKS

THE SKINNER CHUCK COMPANY • NEW BRITAIN, CONNECTICUT

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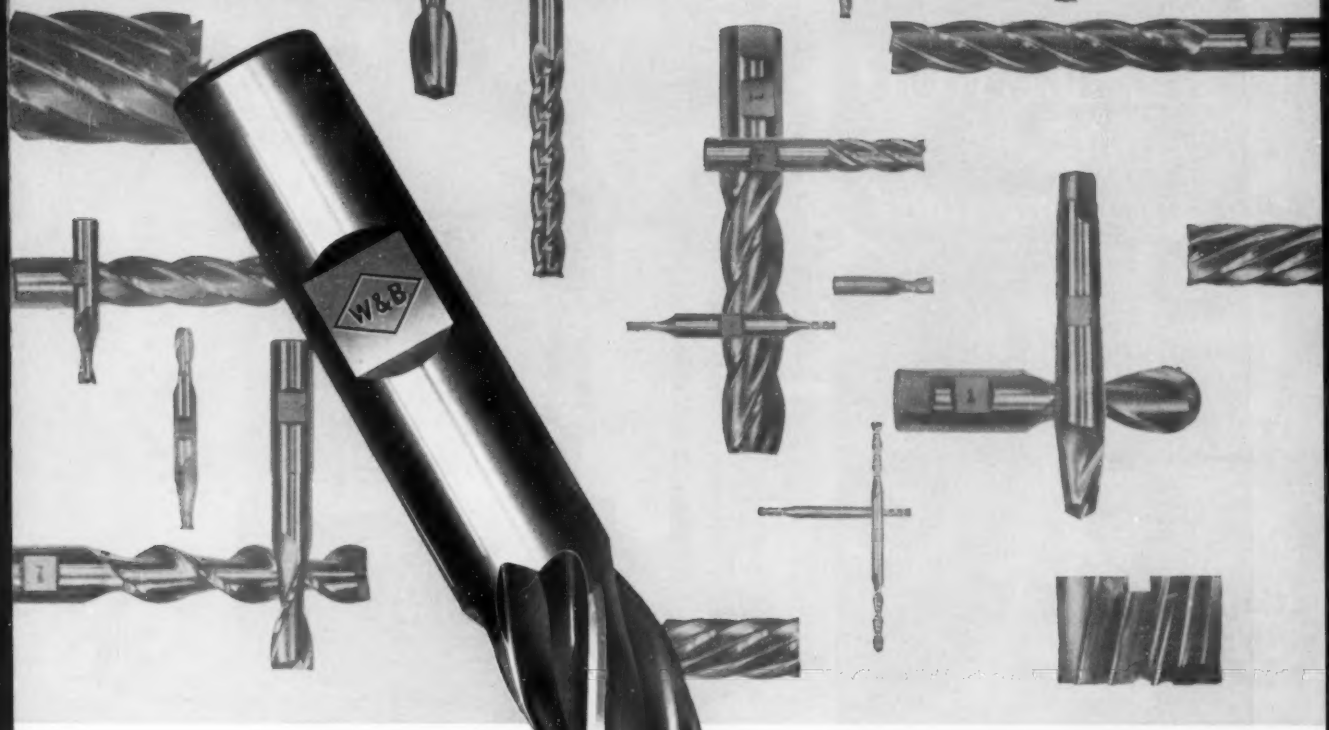
W&B END MILLS

Designed Better To Mill Better



1 Newly designed flute shapes afford maximum cutting performance at higher rates of feed.

2 Flutes are machine polished—pockets are eliminated. Chips are easily cleared, assuring a free cutting action.

3 New clearance and precise polishing of flutes provide greater accuracy and control of size.

4 Sharp corners and stress points have been eliminated to provide greater strength, less breakage.

5 New style clearance strengthens cutting edges, prevents flaking or chipping.

6 New flute shapes and chip clearing ability reduce wear on cutting edges.

Every Feature Says Compare!

Try W & B end mills on your milling operations . . . a comparison will demonstrate their superior performance. Your local W & B distributor carries a complete stock of standard, off-the-shelf types and sizes. He offers you the best in service and delivery on end mills for any standard application—so, to make your own performance comparison, call your industrial distributor today!

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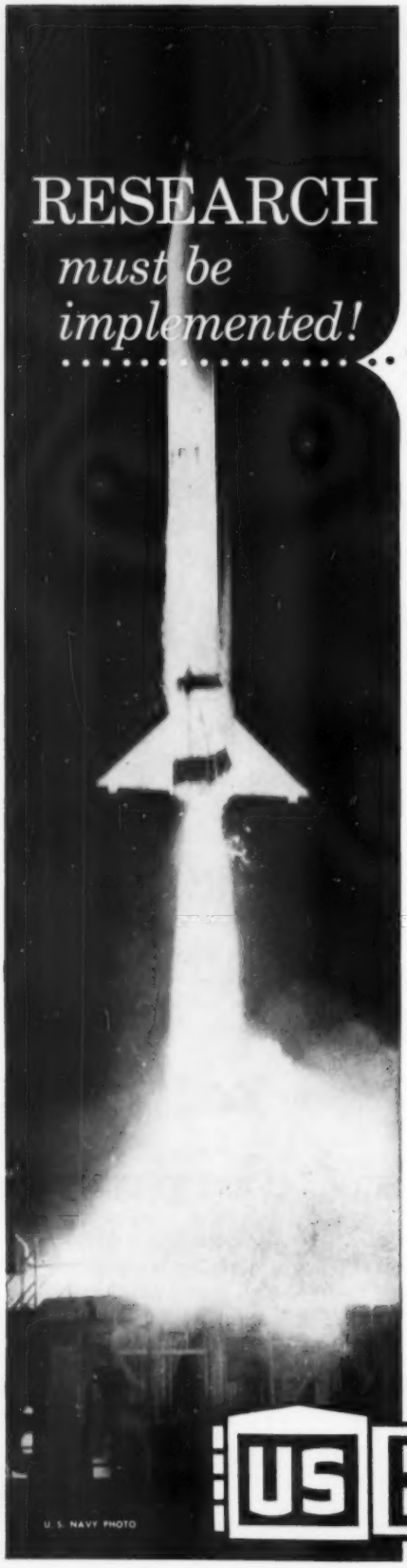
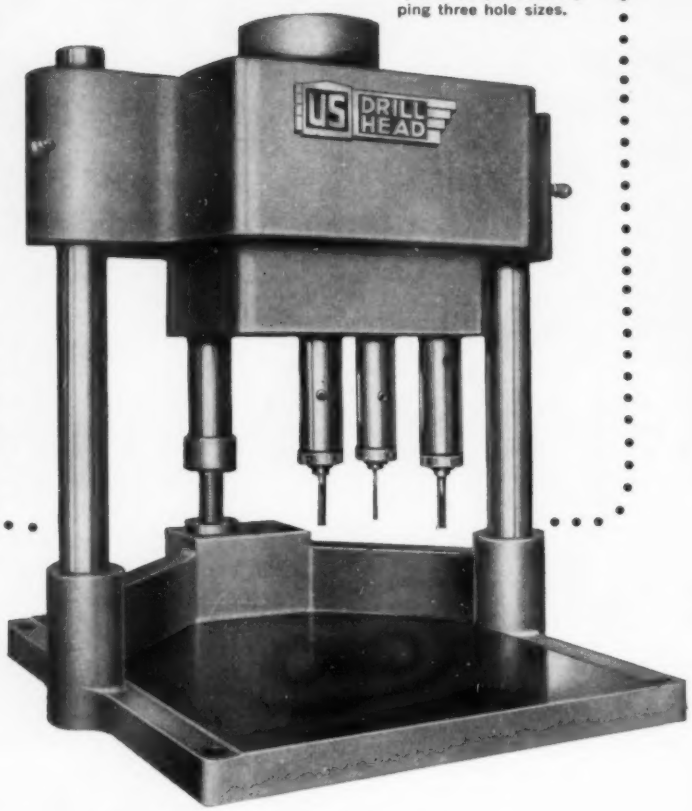




3-spindle U. S. Fixed Center Head with auxiliary lead screw tapping spindle for precision tapping three hole sizes.

. . . and, that's the business of manufacturers.

In practically all manufacturing, the most common operation is the production of holes. And, for cost-reducing production of precision multiple-hole patterns in your manufacturing— that's OUR BUSINESS!

Get low-cost

MULTIPLE-HOLE LEAD SCREW TAPPING ON A DRILL PRESS with U. S. Heads

Where precision tapping of multiple-hole patterns is required on high or low production runs, do the job on a drill press with a U. S. Master Lead Screw Head. These special fixed center heads are built with varying number of spindles and tap sizes in any one head—exact gear ratio required to each spindle as well as to master lead screw. Use on any drill press having reversing spindle.

Ask Our Engineers To Talk With Yours

US DRILL HEAD

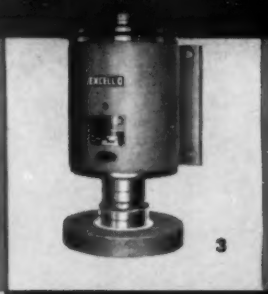
Adjustable and Fixed Center Multiple Drilling Heads.
Individual Lead Screw Multiple Tapping Heads.

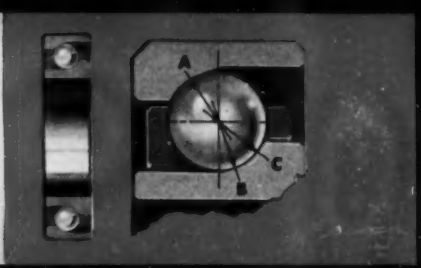
UNITED STATES DRILL HEAD CO.

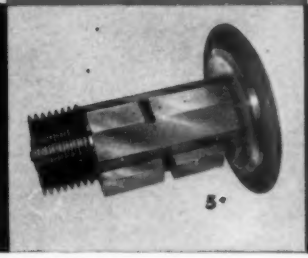
BURNS STREET • CINCINNATI 4, OHIO

EX-CELL-O SPINDLES

RUN TRUE







1. High-frequency, 25,000 rpm motorized type.
2. Cutter grinder model; 3600 rpm inbuilt motor.
3. Vertical units fit many power requirements.
4. I.D. type adapts to most machines.
5. Form grinder spindle; 25 h.p. capacity.

Cross-section drawing (above right) of single-row bearing shows points of ball contact (A, B and C) on tracks in race.

59-27

EXCLUSIVE RADIAL THRUST BEARING DESIGN PUTS PRECISION INTO PRODUCTION GRINDING

What makes Ex-Cell-O Precision Grinding Spindles run true? Engineering experience, skill in precision production and assembly, quality materials—and perhaps most important, the famous Ex-Cell-O Precision Spindle Bearing!

Made by Ex-Cell-O for use only in Ex-Cell-O Spindles, this custom-made bearing is the product of a unique Ex-Cell-O process which develops tracks or pathways in the race. The ball contacts the race only at these narrow, mirror-smooth bands (see detail above).

As a result, the bearing runs cooler at high speeds; wear is reduced, rigidity is improved, and spindle accuracy is measurably increased.

In widespread original equipment use, Ex-Cell-O Spindles are also an economical means of increasing speed and accuracy in older I.D. or O.D. surface and thread grinders, tool and gear grinders and similar equipment.

See your Ex-Cell-O Representative, or write direct for details on the complete line of Ex-Cell-O Precision Grinding and Boring Spindles.

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DETROIT 32, MICHIGAN

XLO Machinery Division

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

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Nancy Anderson

–methods engineer

Here is a consumer with low income and high expectancy...

In ten years Nancy will be looking for a new automobile, a home, a dozen different appliances, and an antique coffee-grinder lamp.

Surely any product that is not improved every year will not be on Nancy's list. But with costs still rising, how do you increase quality without danger of overpricing?

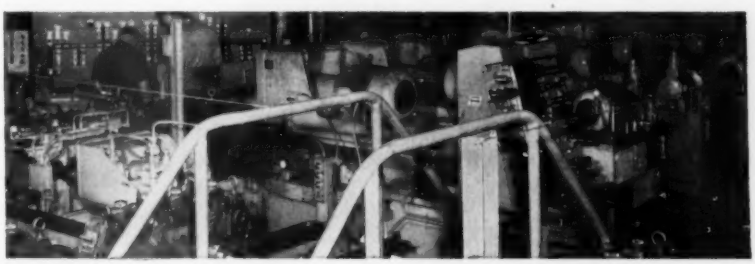
There is a way . . . by increasing utilization of existing and new machine tools. After all, why should machines be operated at from 56 to 85 per cent efficiency? Major costs nowadays are caused by machine-hours wasted—not undermechanization.

Tooling that speeds setup . . . minimizes downtime for changing and resetting tools . . . reduces regrinding cost . . . and keeps tools in the cut . . . can chop *total cost* and increase return on capital.

This is one way to make something at a cost that will make Nancy buy.

How Optimation Tooling can increase return from high-production machines

Profit improvements now made possible by realistic tool control and reduction of tool-change downtime



The most dramatic savings ever offered users of high-production machines now can be had for a modest tooling expenditure.

Scully-Jones Optimation Tools on single-purpose transfer machines, double-end trunnion machines, around-the-table index machines, multiple-spindle automatics, and single-spindle chuckers reduce downtime caused by tool change, tool adjustment, and tool breakage. These three factors account for 75% of all downtime on transfer machines.

It is machine downtime that makes cutting tools eight times more costly *in use* than their acquisition cost. That's why Optimation Tools pay for themselves in increased running time, alone. But other advantages overshadow these savings.

Lower tool replacement cost, which includes related downtime, calls for higher machine speeds. Because the lower the cost, the faster you can wear out tools. Speeds on your limiting spindles can be increased to reduce cycle time. This minimizes piecepart costs—an objective any comptroller will agree deserves more attention than long tool life.

One plant is saving $42,000 per week from an Optimation tool-change and tool-control system on transfer machines. Another is producing 748 extra parts in the time saved for one tool change on automatics. A screw machine products plant increased production from 600 to 990 pieces per shift. Another plant reduced piecepart cost from $4.00 to $2.16. An appliance plant reduced time for 12 tool changes from 108 minutes to 9 minutes. Here are examples.

TRANSFER MACHINES

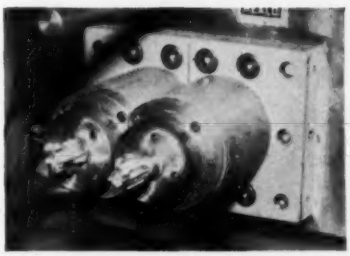
This Buhr 26-station transfer machine (above) does 57 operations on pump housings. Scully-Jones Better-Hold chucks are used for rough-boring, spot-facing, and chamfering. They reduce downtime for changing and adjusting tools. Here's how they work.

A powerful, concentric drive is applied to the tool shanks simply by twisting the lock-and-eject actuating collar. This draws a split collet with tapered OD into compression against a mating taper on the ID of the chuck. An adjusting

nut on the end of the cutter shank and stop nut in the spindle permit accurate presetting for depth. There are no in-the-machine adjustments—it's twist, tighten, and start cutting.

Scully-Jones Toolitrol boards make convenient "centers" for storage, identification, and presetting tools. Counters provide visual warning of conditions in each head. They control number of stoppages, and reduce sharpening costs.

Another example is these Better-Hold chucks for counterboring and reaming operations on a Heald transfer line that does complete machining on lower valve bodies for automatic transmissions. The body of the chuck, to which the



actuating collar is attached, mounts directly to the spindle face plate.

AUTOMATICS

These preset, quick-change holders reduced tool changing cost from $4.14 to $0.103 in a multiple-spindle automatic. Efficiency jumped from 60% to 85%. The operator just inserts the holder, with adapter, and twists to lock it in the machine.

Adjustable adapter permits accurate presetting outside the machine. Setup conditions are simulated by presetting tools and fixtures on a Toolitrol board. All adjustments are made with the machine cutting.

TOOLING SURVEY

Our engineers will study your machines and give you a complete tooling analysis. Phone: BIshop 7-5900.

SCULLY JONES

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1915 So. Rockwell Street, Chicago 8, Illinois

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do all these operations—*and more*
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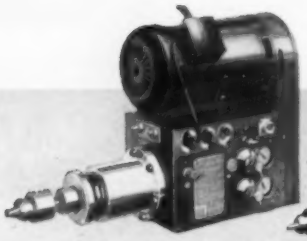
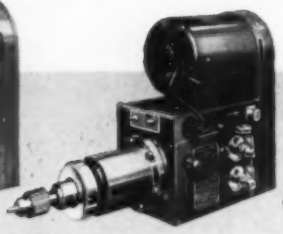
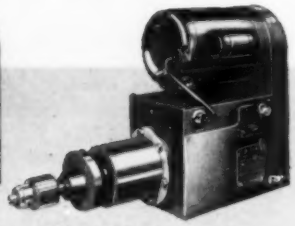
PLUG THEM IN AND THEY'RE READY TO GO—Any unskilled laborer can learn to operate them in minutes. Once set, they're always set—minimizes scrap loss, drill breakage, and eliminates slowdowns due to operator fatigue. Change is easy and quick from job to job, operation to operation, for long or short production runs. Precision engineering, famous Dumore quality workmanship and separate, isolated hydraulic and pneumatic systems provide trouble-free service over millions of cycles. Use less air than a small hand tool. One cu. ft. of compressed air provides up to 350 strokes 3" long . . . a real cost-cutting feature.



SERIES 28
Drills or taps at the flip of a selection switch. Tap fits into chuck, no extra attachments required. Reversing motor controls tap, eliminates troublesome clutches. Spindle speeds from 265 to 4900 rpm. For long or short runs.



SERIES 24
Fully automatic with all controls built-in for long or short runs and frequent changeovers.



SERIES 26
Identical in size and capacity to Series 24 with just basic controls built-in for long, uninterrupted runs.

SERIES 20
For high production drilling of small parts. Automatic built-in controls. Sets its own feeds and speeds by resistance of material to drill. No. 80 to 5/32" drill capacity.

NOSE MOUNTING BRACKET

YOUR KEY to all-purpose machining—**anywhere.** It permits fast, easy mounting in any position, angle, or direction in single or multiple unit set-ups. Changeovers to other operations, when required, are made quickly, speedily. Return to original set-up is equally fast.

and these building-block accessories...

. . . let you use any Dumore Drill Unit where you can make the most of its versatile capacity. On drill press columns for single or multiple spindle applications; or added to single or multi-purpose production set-ups, transfer machines and other automatic systems. By combining several units, many machining operations on parts can be achieved in one set-up.

COMPLETE DRILL PRESSES
Includes head, mounting bracket, circular or rectangular table, column and base.

CIRCULAR AND RECTANGULAR FIXTURE PRESSES

CROSS ARM BAR ASSEMBLIES
For opposed unit, horizontal mounting. Units can be adjusted along cross arm in relation to central fixture.

CIRCULAR PRODUCTION TABLES
Provide mounting space and circular adjustment for several Units to simultaneously machine small parts in central fixture.

NEW MULTIPLE SPINDLE ATTACHMENT
Fits Units 24, 26 and 28. For simultaneous drilling or tapping of 2, 3 or 4 holes. Spindle center distances quickly changeable.

HYDRAULIC FEED CONTROL
Separate, self-contained adjustable feed control for use when required on special application. Can be installed in minutes.

REPEAT CYCLE TIMER
Provides automatic woodpecking for drilling deep holes. Reciprocation can be adjusted to hole depth and drill size. Clears chips and permits coolant to drill point.

BRACKETS
All sizes for mounting on all standard drill presses.

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Your Name_____

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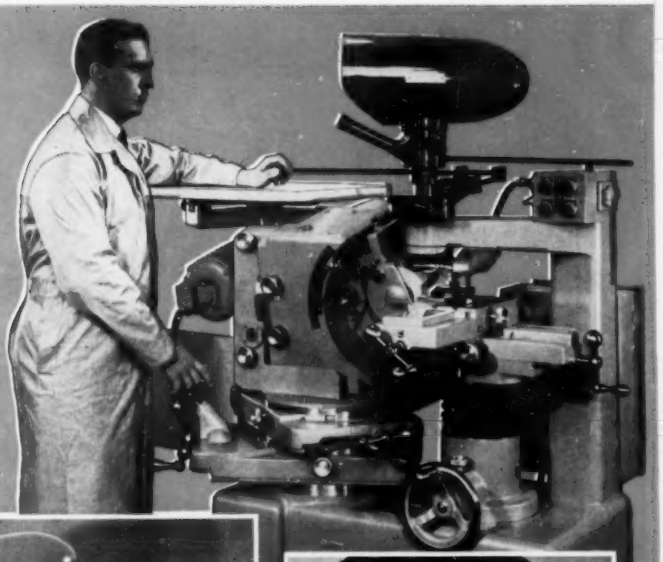
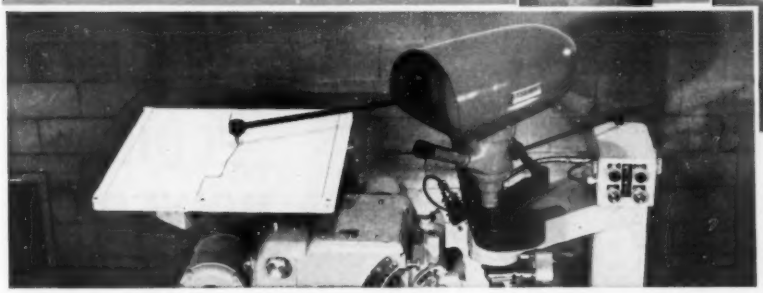
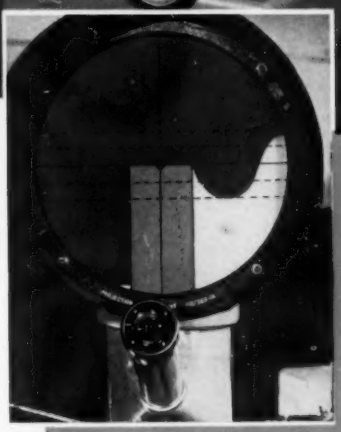
Grind High Precision Profiles Directly from the Drawing *with* SHEFFIELD'S MICRO-FORM GRINDER







FEATURES

- Grinds both flat and circular profiles
- No restrictions on profile intricacy
- No templates needed
- Perfect toolroom accuracy
- Saves up to 75% on profile work
- Final accuracy checked while work is still on the grinder
- Accuracy not affected by wheel wear
- No special wheel dressing required as wheel can be set at any angle—fewer wheels are needed
- Diamond impregnated wheels used in grinding carbides last longer—no waste as no special dressing is required
- Multiple work parts ground simultaneously
- Grinds any material including carbides
- Controlled by 50:1 pantograph and 30 power scope and viewing screen

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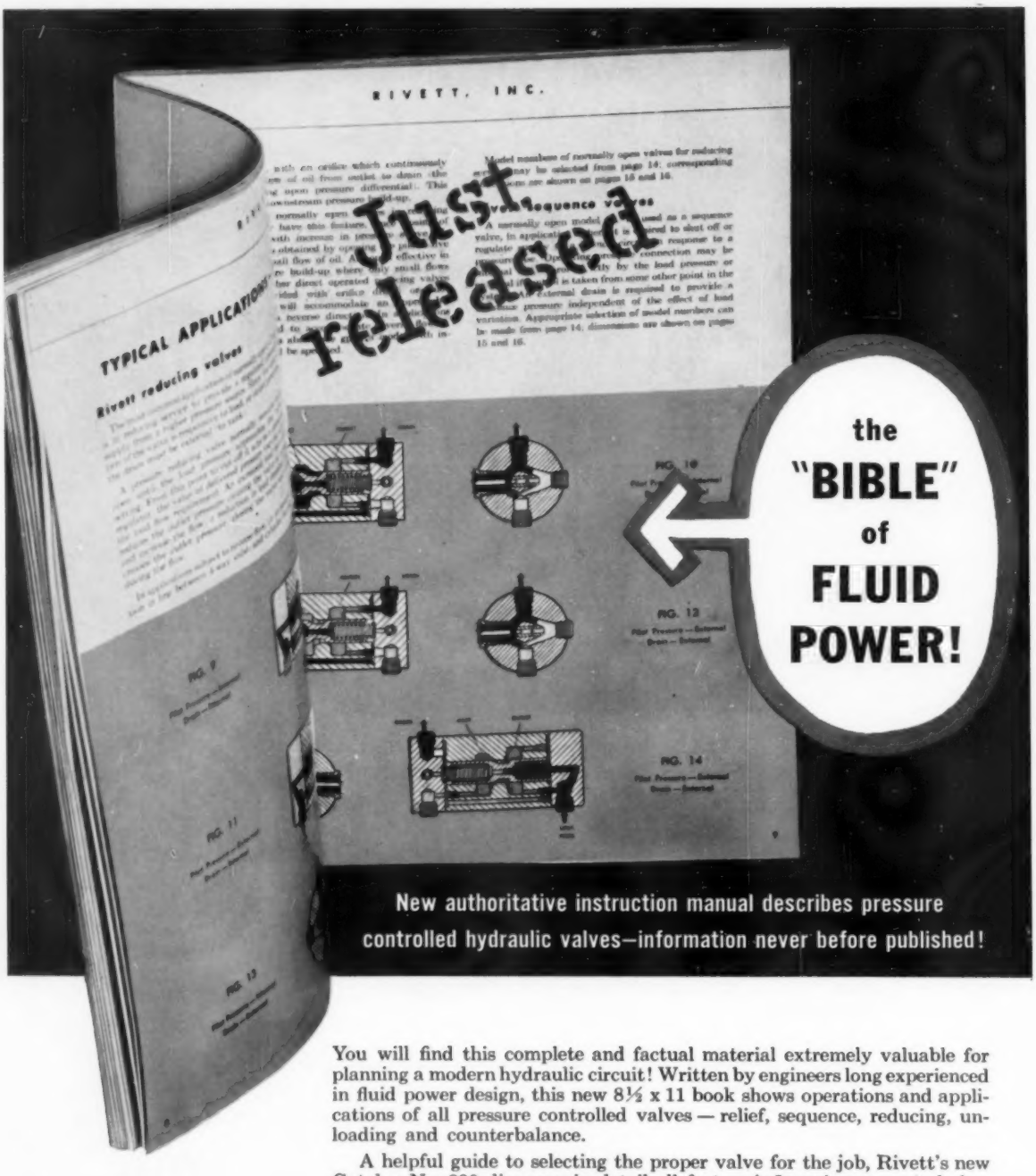
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New authoritative instruction manual describes pressure controlled hydraulic valves—information never before published!

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A helpful guide to selecting the proper valve for the job, Rivett's new Catalog No. 230 discusses in detail all factors influencing correct choice: normal spool position, operating pressure source, pilot or direct operation. Also shown are flow diagrams, pressure vs. flow curves, ratings, dimensions, drawings and specifications.

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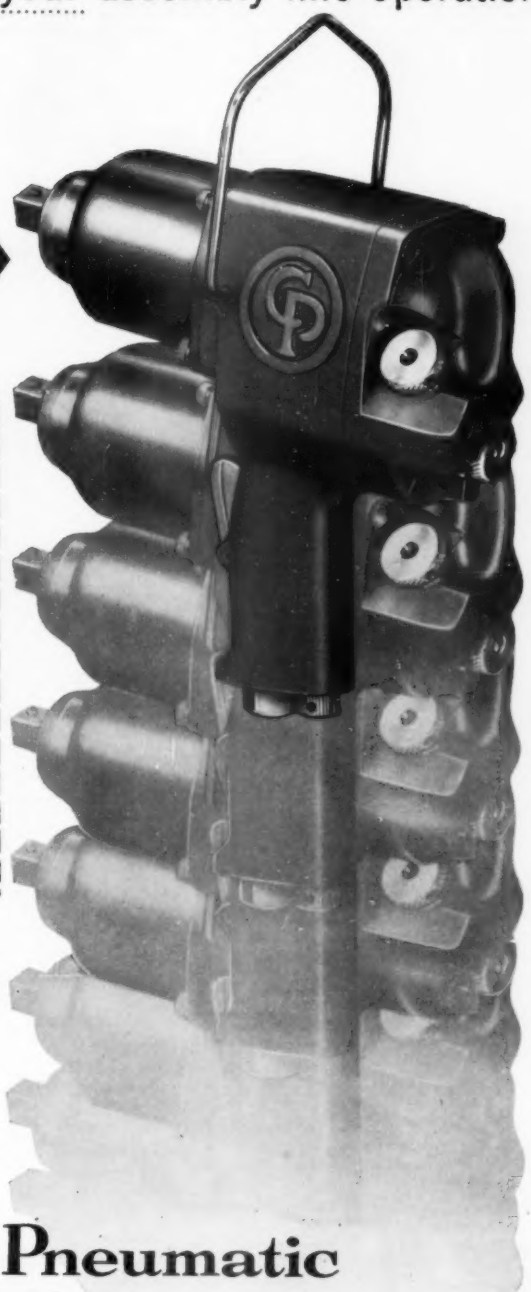
PROPER BOLT TIGHTNESS

in your assembly line operations!



CP-3440-TS adjustable torque range 15 to 80 ft-lbs. ½" square drive.

TORQUE CONTROL IMPACT WRENCHES

CP-3630-RTP adjustable torque range 100 to 350 ft-lbs. ¾" or 1" square drive.

CP-610-RTP adjustable torque range 300 to 600 ft-lbs. 1" square drive.

✱ A complete line of Torque Control Screwdrivers and Nutrunners solve other threaded fastener torque problems. Available from No. 4 screw size to ⅜" bolt size.

More and more top-flight manufacturers are realizing that *proper bolt tightness* is a quality factor that gives them a sales edge over competitive products . . . their assembly line foremen know that the use of TORQUE CONTROL IMPACT WRENCHES in the driving of nuts and bolts to "correct torque" means:

- Less work spoilage
- No chance of sheared bolts or stripped threads
- Inexperienced operators learn nut running operations faster
- Less product failure

CP Torque Control Impact Wrenches give you the exact tightness you want in a fast, accurate, "one-shot" rundown that doesn't require a hand torquing follow-up to check work accuracy. Torque ranges from 15 to 600 foot pounds available.

Let a CP Fastener Specialist work with you on your problems. You'll be impressed by the easy handling qualities of these unusually compact tools. The torque control mechanism is totally enclosed and *all torque adjustments* are made quickly AND simply without special tools or fixtures. For further information, contact your nearest CP Office, or write: *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, N. Y.*

Chicago Pneumatic

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Howard Beacham tripled wheel life,

Howard Beacham has been a Bay State Abrasive Engineer for fifteen years and his total experience is double that. He's worked on grinding problems that have involved every type of metal in jobs as tiny as miniature bearings and as big as the world's largest air compressors and steam turbines.

cut dressing frequency in half at New Process Gear

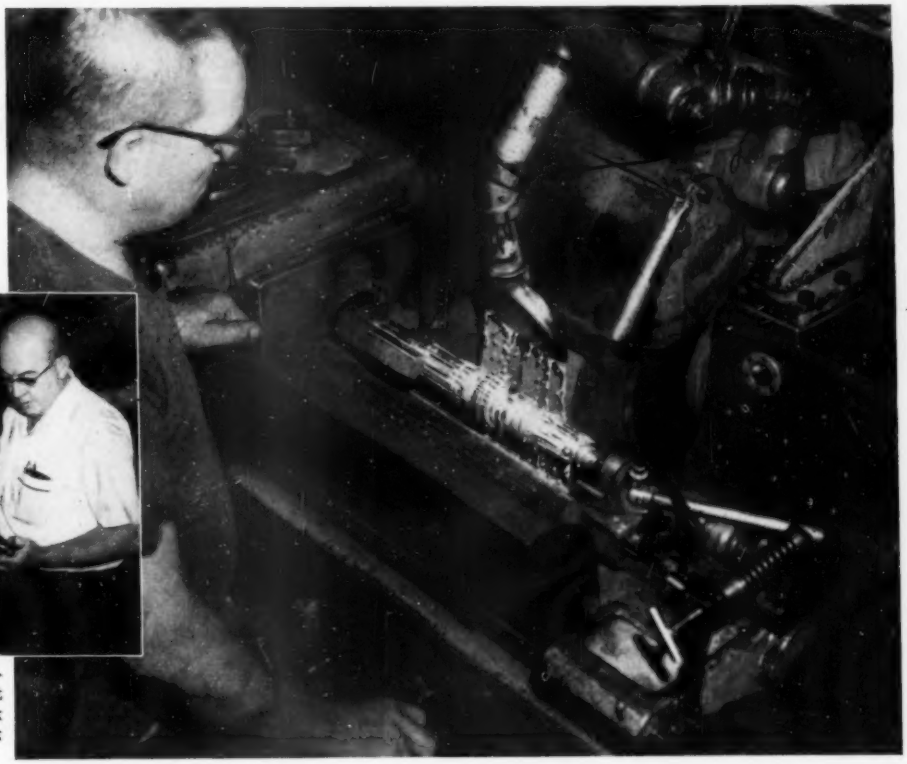
The closer you get to automation, the more it hurts to have production interrupted. That was the principal problem at Chrysler's New Process Gear Division where semi-automatic grinding of flats on truck transmission shafts was halted by wheel dressings every eleven pieces.

The three competitive wheels used in this simultaneous "cam grinding" operation wore down so fast they had to be replaced every week. And, on top of that, an alarming number of shafts were being cracked during the grinding operation.

Bay State's Howard Beacham was called in on the job. He specified a trio of Bay State wheels that produced really spectacular results.

Production jumped to twenty-five perfect shafts per dressing and wheel life went up to three full weeks. Finish was excellent, too.

Why not talk to your own Bay State representative next time you have a grinding problem? Like Howard Beacham he's a trained specialist. *Better grinding at lower cost . . . that is his business.*



Operator Henry Kotas runs grinder equipped with one 24 x 1-21/32 x 12 and two 24 x 1-3/4 x 12 Bay State wheels. The three wheels simultaneously grind flats on main shaft for 5-speed truck transmission.

(*Above*) Manufacturing Engineer Wiley Bell and Plant Superintendent Nelson Fisk examine finished truck transmission shaft.

BAY STATE WHEELS of PROGRESS

BAY STATE ABRASIVES

Bay State Abrasive Products Co., Westboro, Massachusetts.
In Canada: Bay State Abrasive Products Co., (Canada) Ltd., Brantford, Ontario.
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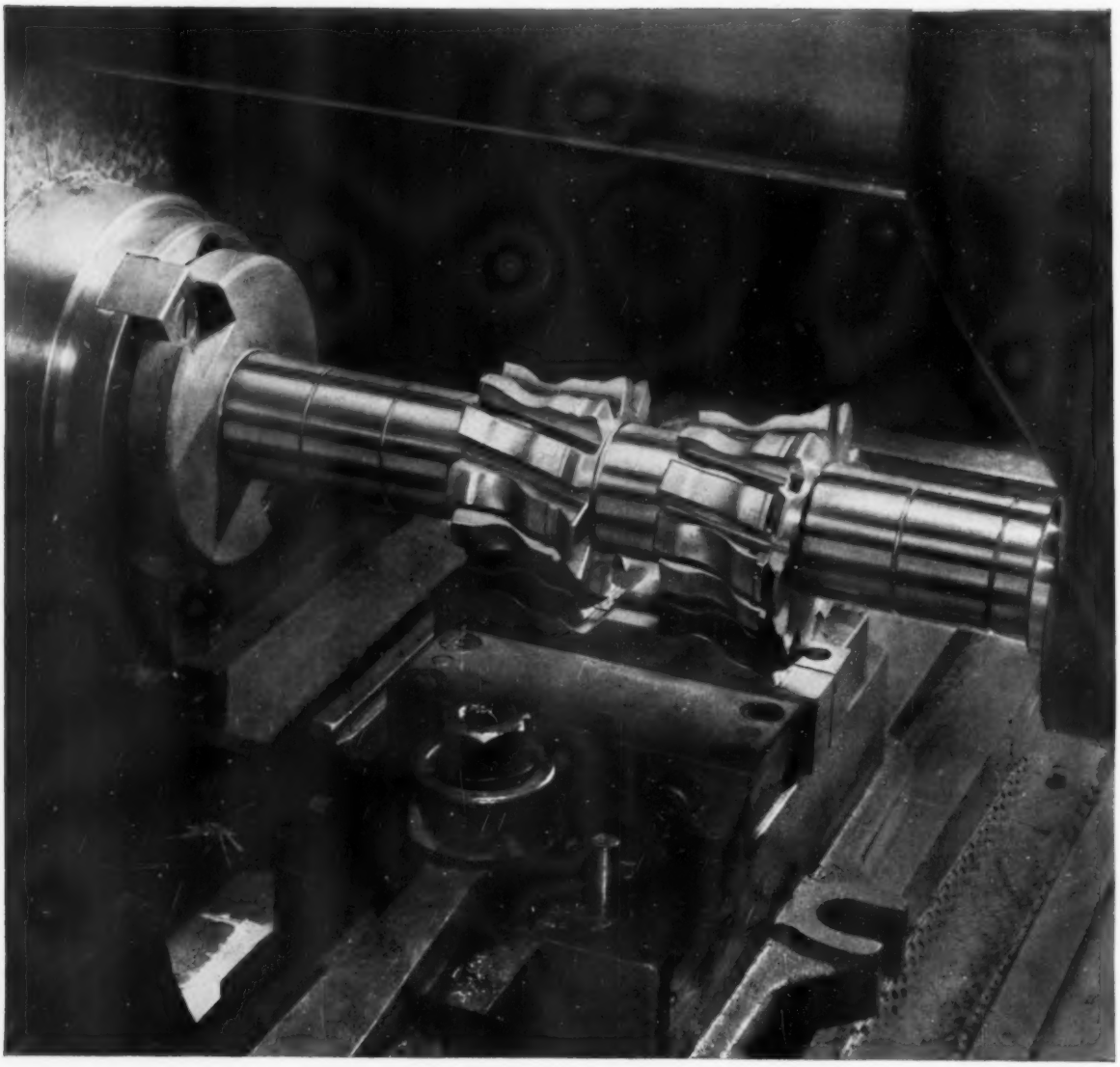
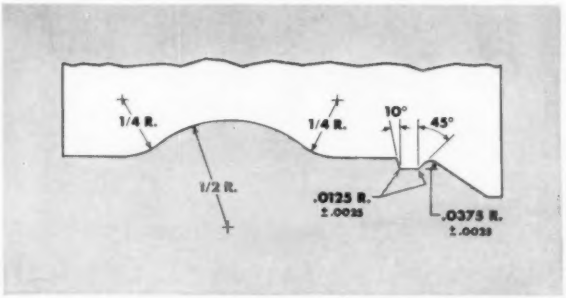
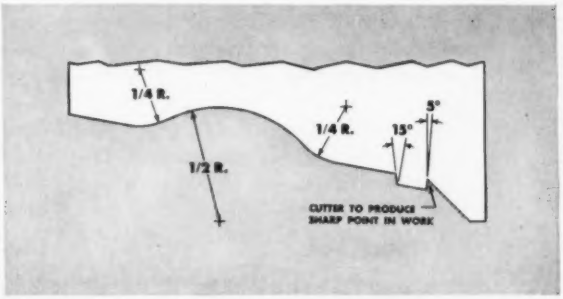
Mill Odd Shapes

...with Barber-Colman Form-Relieved Cutters



in One Operation





Two different pieceparts . . . complex forms . . . precision tolerances. All are combined in one milling operation, using Barber-Colman *unground*, form-relieved cutters.

These helical-fluted cutters are made interlocking to produce a sharp point, as shown on the drawing. Since they are of the form-relieved type, form can be maintained easily by sharpening the tooth faces.

But, the job of controlling work quality and production costs depends upon the fine points of cutter design and manufacture. In this case, for example, several difficult dimensions are held to ± .002 in. This means dimensional distortion and growth in heat-treating must be predicted accurately and compensated for in design. Sharpening, steel specifications, heat-treatment, and surface finish — all affect performance on the job. They are dependent entirely upon the capabilities of the maker.

Barber-Colman's modern new cutter plant is equipped with advanced engineering and manufacturing facilities to keep close watch on these important factors. For example, accurately ground form tools produce a smooth unground finish on the cutter teeth in the form-relieving operation. This assures maximum tool life by eliminating rough edges — a common cause of wear on the flanks. Also, because all Barber-Colman cutters are *index-sharpened*, your sharpening costs can be minimized. The job can be done on an automatic sharpener. Original tolerances are maintained easily throughout the life of the tools.

Cutter engineering service...

These five services become adjuncts to your own methods department when you submit a milling problem to Barber-Colman Company:

1. *Application engineering* — on-the-spot evaluation of milling problems by experienced tool designers.

2. *Design engineering* — highly specialized tool engineering, backed by electronic computer facilities for fast, accurate calculation of complex tooth forms.

3. *Metallurgical engineering* — specially selected steels and heat-treatment for your particular material and tool geometry.

4. *Manufacturing* — the most complete and advanced processes under one roof for producing exactly the right finish, highest accuracy, and *any* cutter style.

5. *Quality control* — optical master inspection, seven different control stations, and numerous separate inspections for individual cutters.

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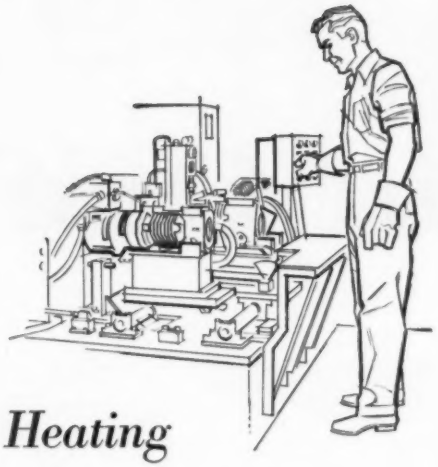

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In the assembly of motor-compressors for their air conditioning and refrigeration products, Copeland Refrigeration Corporation formerly employed air presses for force-fitting their 1/5 HP through 1½ HP motor housings and stators. This method was costing Copeland $100,000.00 annually in labor, material and quality control expense to maintain the high quality of its product.

TOCCO Shrink-Fit Method

To reduce these costs, Copeland installed a 30 kw, 10,000 cycle TOCCO Induction Heating Unit. Motor housings are heated to 400° F. resulting in up to .013" expansion. After cooling, the motor housing shrinks to form a predictable and perfect fit with the stator. Stator scoring and distortion are eliminated and $100,000.00 annual saving realized.

Whether your production problem is shrink-fitting or higher temperature applications such as brazing, heat-treating, forging or melting, look to TOCCO for an economical solution to any metal-heating problem.

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It's Up To You!

Every person in our manufacturing world, holding responsibility for production, likes to think that he is up with the times.

Many of us, as we advance in years, are prone to complacently develop habits uncomplimentary to our responsibilities.

Technology is moving rapidly ahead. Competition at home and abroad, coupled with a sputnik scare or two, has caused some to take a new look. Renewed emphasis on education of all kinds, particularly in science and manufacturing, is the order of the day.

Some excerpts from my book of notes furnish food for thought:

Be interested in the future, you'll spend the rest of your life there.

Plan ahead, think ahead, keep ahead!

Obstacles are very often opportunities in disguise, if you discuss them with an expert.

Every man reaps what he sows except the amateur gardener.

Tomorrow is too often a man's busiest day.

It's hard to live within your income, but living without it is worse.

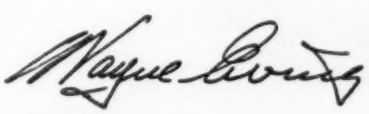
Progress in every land is the fruit of education and application. Those who learn and apply will do more—those not interested enough to make an effort will contribute no more than necessary and, accordingly, will reap no more than minimums.

Vacations are over, school bells are ringing—it's time to get serious about our immediate problems and future plans.

Let us dedicate at least one night a week to self-improvement. Attend and participate in a chapter meeting, Read THE TOOL ENGINEER from cover to cover. Make use of other technical journals. Discuss a complicated problem with other tool engineers. You will be surprised how pleasant and profitable this habit can become.

Do you have the ambition to progress with us, or just stay where you are?

See you around!



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Quick guide to toolroom requirements

DRILL ROD

Carbon Steel Drill Rod—A high-grade drill rod with smooth finish and extreme size accuracy.

Ry-Alloy® Drill Rod—Non-deforming . . . excellent finish, accurately sized, free from decarburization.

Ry-Alloy Ground Flat Stock—Accurately ground on all four sides. Ends and sides are square, parallel, and accurate to dimension. Free of surface decarburization . . . spheroidize-annealed for best machinability.

TOOL STEELS

Ry-Alloy Tool Steel—An oil-hardening steel. Combines high hardness and deep hardness penetration with minimum distortion, freedom from cracking. Good machinability.

V.D.® Tool Steel—An all-purpose, water-hardening carbon vanadium steel. Easy to machine . . . hard and tough after heat treatment. Hardening characteristics permit wide variation in treatment with uniformly good results.

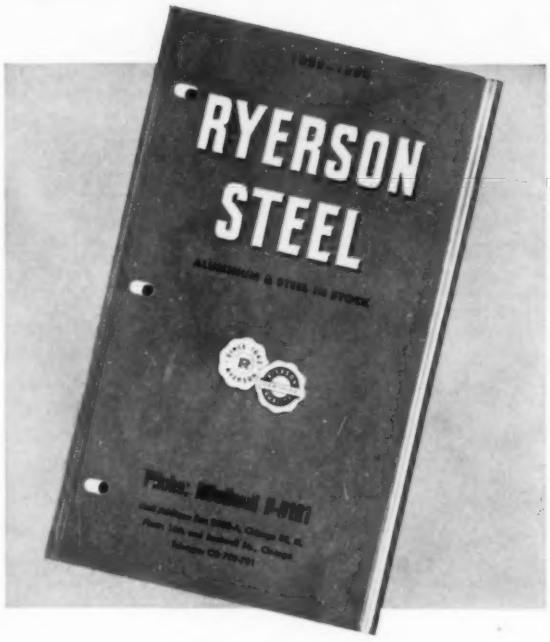
V.D. Chisel Steel—A specially developed, water-hardening carbon molybdenum tool steel ideal for hand and pneumatic chisels.

Tool Steel Sheets—Rolled from high-grade tool steel of about 1.00% carbon. Smooth, blue finish protected by oil. Can be hardened in oil or water; quenching medium depends on hardness desired. 27 gauge up to 3/16″ thick.

AISI-E 6150—For impact applications. Provides relatively high surface hardness while retaining strength and toughness throughout the cross section.

Carbon Steel Plate—All sizes and thicknesses.

E-Z-Cut® Plate—Remarkable free-machining qualities make this plate ideal for die bases, jigs, rubber molds, etc. Up to 30% savings in machining time compared to ordinary steel—with approximately 50% increase in tool life.



ALLOY STEEL PLATE

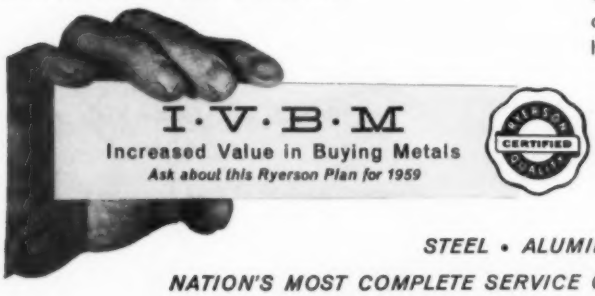
4140 Plate—An oil-hardening, annealed plate of firebox quality. Specially developed for maximum strength and uniform hardenability throughout the cross section. Thicknesses from ¼″ through 5″.

E 8615 and 8620 Plate—These oil-hardening, case-hardening alloys are ideal for flats, rings, discs and irregular shapes. Accurately flame-cut to your order.

Cold Finished Bars—A wide range of analyses. Rounds to 10″; squares to 4″; flats to 12″ x 2″.

Stripper Plate—Both surfaces ground and polished to a thickness tolerance of plus or minus .003″. Edges planed instead of sheared or rolled, insuring parallel sides free from strains. Warping and distortion after machining practically eliminated.

In addition to all the requirements listed above, call Ryerson and choose from the nation's largest stocks of standard and aircraft quality alloy steels. Whatever your requirements, contact your Ryerson representative for widest selection, highest quality, fastest shipment, complete satisfaction.



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Surface Specifications ...their use and meaning

By Charles H. Good*
Plant Manager
Micrometrical Manufacturing Co.
Ann Arbor, Mich.

Some degree of surface irregularity is inevitable and often desirable. The extent to which finish is controlled depends largely on an understanding of surface specifications and their application.

SURFACE SPECIFICATIONS, like tolerances, should convey a specific idea from the designer to the tool engineer, but quite often improper use of surface specifications results in mutual disagreement. The principal reason for this is the use of an incomplete specification. The surface specification, *Fig.* 1, includes seven separate values, but in 90 percent of all cases only one is required, and in 99 percent of all cases only one is specified. It is in the cases where a more complete specification is required—and not specified—that problems arise.

Roughness: Most of the time, a single finish is specified and anything better is all right, but in some cases this type of specification can cause trouble. For example, early specifications on brake drums called for an 80-microinch finish. The drums functioned well until the machining process was improved and then the brakes no longer worked. The cause of this failure was that the finish was below 32 microinch and the friction force was too low. An upper, as well as a lower limit, is now specified on brake drums to strike a balance between wear and braking qualities.

Painted areas are excellent examples of the need for both an upper and lower limit on surface irregularity. Too rough a surface will show through the paint and paint will not adhere to an excessively smooth surface.

Such examples point up the frequent need for an upper, as well as a lower, limit on surface roughness, and the designer who can anticipate these needs facilitates the manufacturing process. This is of particular importance when the finish specified is on the high side for the machining process selected. As an example, a part might be ground

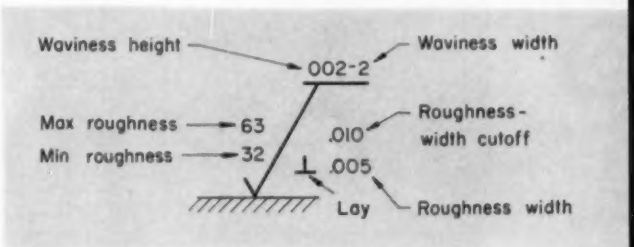


Fig. 1. The complete surface symbol specifying maximum and minimum roughness, waviness and lay.

*Senior member ASTE Ann Arbor chapter.

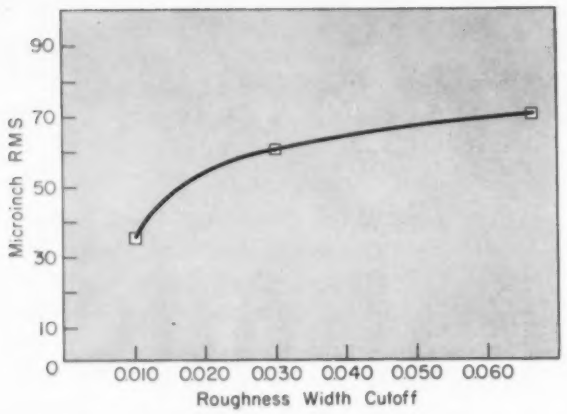


Fig. 2. Increasing roughness width cutoff increases the roughness readings obtained.

to a 63-microinch finish because it is difficult to get a consistently smooth finish by milling. However, it is not too difficult to obtain a 32-microinch finish by grinding. Thus, if the original specifications of a surface had been 63 microinches and the part worked well when milled but did not function properly after grinding, the conclusion might be that it was possible, with no extra effort, to make the surface too smooth. The solution again would be to put a lower limit on the finish specification as well as an upper limit on the average roughness height.

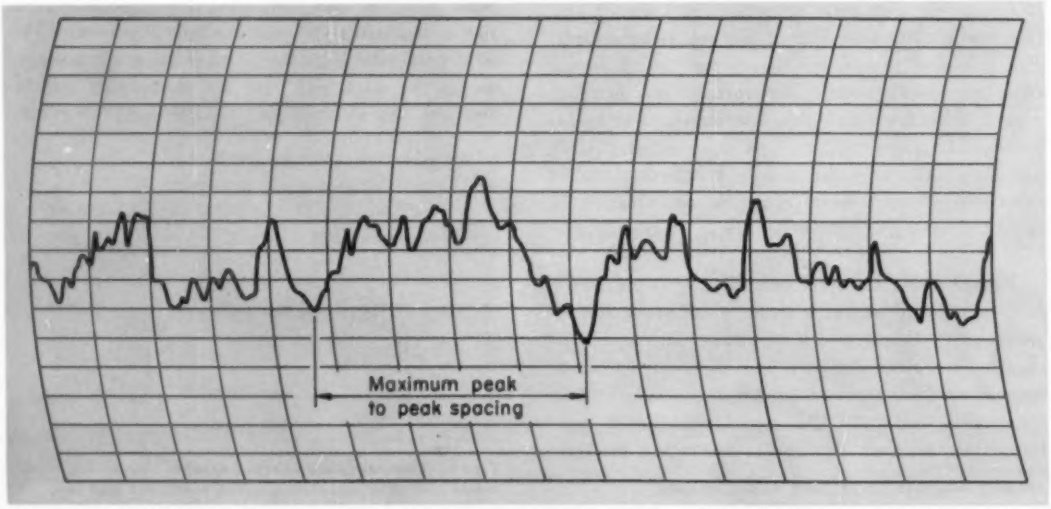
Cutoff: Width of spacing, as well as the height, is important. The standard symbol allows for the specification of roughness width. Though the roughness width is rarely specified, it can be used if the designer would like to control the feed used in processing. For instance, if a surface is to be a bearing surface and the designer wants a light feed to obtain a large bearing area with minimum amount of wear-in, he can specify a narrow feed by specifying the roughness width.

Roughness width cutoff is important. Roughness width is a specification of the surface. Roughness width cutoff is a specification of the inspection instrument. It represents the widest spaced, peak-to-peak irregularity whose height will affect the average roughness reading of the instrument. The importance of roughness width cutoff is best shown by noting the effect of roughness width cutoff on the roughness measurement on a given part. *Fig.* 2 shows the effect on the roughness reading caused by increasing the roughness width cutoff of the instrument. In this example an aluminum specimen was milled with a feed of 0.004 inch per tooth. Had the supplier used older equipment limited to a 0.010-inch cutoff, his measurement would be 33 microinches. If the customer's checking equipment had a 0.030-inch cutoff, his reading would be twice that of the supplier's, all of which would lead to a possible rejection of the part.

This cutoff difference between the supplier's and the customer's checking equipment has led to more confusion than any other aspect of surface finish measurement. Surface checking equipment is now being manufactured with a number of different cutoffs available, but the cutoff used must be specified or the problem still exists. In the absence of a specified cutoff, 0.030 inch is to be assumed.

While it can readily be seen that anything that can cause variations of 100 percent in readings is

Fig. 3. Surface profile record. Distance between widest spaced irregularities is used in determining roughness width cutoff.



important, it is important that control of the instrument be understood also. The relationship of width roughness cutoff to the instrument is $R_{co} = S/C_{al}$, where R_{co} = roughness width cutoff, inch, S = speed of trace, ips and C_{al} = low-frequency cutoff of the amplifier, in cps.

An amplifier works only within a certain range of frequencies and if a signal of higher or lower frequency occurs, the amplifier will no longer respond. In this it resembles the human ear, which cannot normally detect sound having a frequency above 20,000 or below 25 cps. This audible range of 25 cps to 20,000 cps is called the cutoff frequency. Like the human ear, an electronic amplifier has a cutoff frequency. Most amplifiers used for averaging type instruments have low cutoff frequencies that range from three to ten cps.

During measurement, the pilotor moves the tracer over the work at a fixed rate of speed. This fixed speed is normally in the range of from 0.1 to 0.3 ips. The rate of speed and the peak-to-peak spacing of the surface determine the frequency of the signal fed to the amplifier as shown in the formula: $S/P_p = f_s$. In this formula, P_p = peak-to-peak spacing, inch, and f_s = signal frequency, cps. The signal frequency must be greater than the amplifier low cutoff frequency to affect the reading.

Assuming that a surface has been machined with a 0.010-inch feed, there will be 100 feed marks per inch. If the speed of trace of the pilotor is 0.3 ips, this means that in one second it will have gone 0.3 inch and thus gone over 30 bumps in a second. Thus, the signal frequency is 30 cps. If the cutoff frequency of the amplifier is 10 cps, then the meter will indicate. If the part had been traced at 0.1 ips and the feed rate had been 0.030 inch, the signal

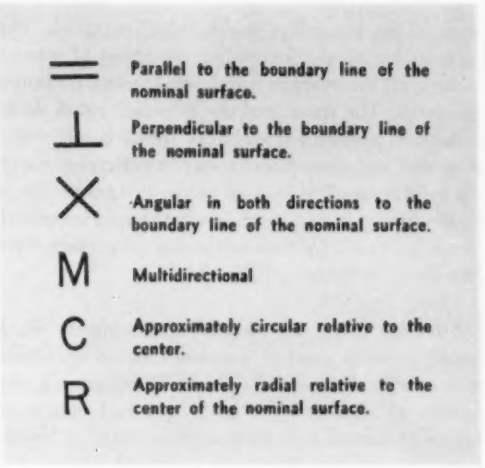

=
Parallel to the boundary line of the nominal surface.
⊥
Perpendicular to the boundary line of the nominal surface.
X
Angular in both directions to the boundary line of the nominal surface.
M
Multidirectional
C
Approximately circular relative to the center.
R
Approximately radial relative to the center of the nominal surface.

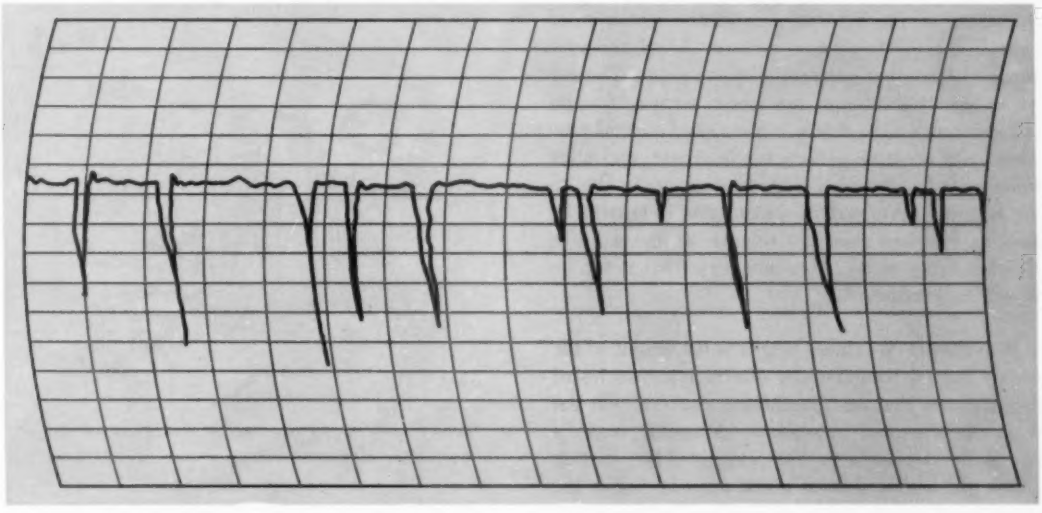
Fig. 5. The tool engineer can specify the type of lay desired by the use of these symbols.

frequency then would be 3.3 cps, which is lower than the 10-cps low cutoff. The amplifier would not pass any signal and nothing would indicate on the meter.

In the first case cited, roughness width cutoff = 0.3/10 = 0.030 inch, which was greater than the feed. In the other case, roughness width cutoff = 0.1/10 = 0.010 inch, which is less than the feed. Feed rate has been used to imply the spacing, but there are other irregularities — wider spaced than the feed — which may affect the function of the part.

There are two ways to determine what roughness width cutoff to specify. First, the variable tracing speed available through hand tracing can give some

Fig. 4. Pitted surface causes deep valleys in surface profile readings but the part may be entirely satisfactory in service.



idea of the roughness width cutoff required. This is done by slowly increasing the speed of manual trace until the average roughness reading no longer increases. The speed and the amplifier cutoff determine the minimum roughness width cutoff value. A second and more positive way to determine roughness width cutoff is to look at the surface profile as shown in *Fig.* 3, and see the widest spaced irregularities not caused by concentrations of surface flaws like those indicated in *Fig.* 4.

Surface Lay: In addition to roughness width cutoff, there is another important aspect of roughness specification—surface lay. There are six categories of surface lay, *Fig.* 5, and each has some degree of influence on the roughness reading. Nearly everyone who has measured a ground surface has measured it both across and with the lay and noticed a large variation in readings. This gives rise to the question "On a turned shaft which serves as a rotary bearing surface, is the finish measured across or with the lay?" As stated in the American Standard (B46.1-1955), the surface should be measured in the direction of trace which gives the maximum reading. While there are little reported data on the effect of lay on the function of bearing surfaces, the indications are that a turned shaft and a sleeve bearing with the same load will last longer or perform better running radially than axially. More specifically, if the shaft and bearing were both turned, and therefore both had lay parallel to the line of motion, the life would be the longest. If the parts had been such that one was parallel to the motion and one at right angles to the motion, life would be intermediate; and if both parts had lay at right angles to the line of motion, life would be the shortest.

Some of the new processes being used today give other lay patterns which affect the function of the part. Most finish versus function charts have been drawn up on the basis of parallel lay, which is, of course, the most common pattern. Until recently, some of the other patterns did not exist. The lay of an electrodischarge machined surface, for instance, is unique in that it is a series of conical pits. These pits serve as pockets for lubricant, and after some wear-in, present a large bearing area. Due to the pattern of this surface, its function in bearing or load applications does not require as fine a finish as other types of lay. How much rougher it can be is still undetermined.

Waviness: Waviness height is the height of the widely spaced irregularities due to inaccuracies of the machine tool and machining process. On flat surfaces, waviness represents deviation from a nominally flat surface. For example, two mating plates which should form a seal must be flat or the seal will not function. On round parts the waviness represents deviation in radius of the part. This is typified by the odd-numbered-point out-of-roundness characteristic of centerless-ground parts. In seals, bearings, spindles, and similar functions, waviness height can be a very important specification.

Waviness spacing is important since it affects the means of measuring. When specified, the waviness width implies the distance over which the height is to be measured. Thus, a 0.0003-2 specification means no waves over 0.0003 inch high in any 2-inch length. If no spacing is specified it could be presumed that the height must be held over the full width of the part or around the circumference of a round part.

It is also essential for the designer to realize what is not being specified, even with a complete specification. Roughness and waviness are considered, but flaws are not. Flaws are faults on the surface due to poor structure of the material or poor handling of the part. These flaws are random in nature but may be concentrated enough to be confused with the roughness of the part. A good example is the porous or pitted surface found on cast iron or hard coated aluminum. As can be seen in *Fig.* 4, the surface, exclusive of the flaws, is quite smooth and would function well, but no doubt would be rejected because it read too high on a roughness measuring device.

All elements of the surface specification are significant, but a caution goes with their use. To overspecify is just as bothersome and expensive as to underspecify. For this reason, the designer should look at the job from the point of view of how the part is to function, how it is to be processed and this will determine how the surface characteristics should be specified.

"Shh—I'm keeping an ear to the ground for the production department so I can alert them for any design changes—"

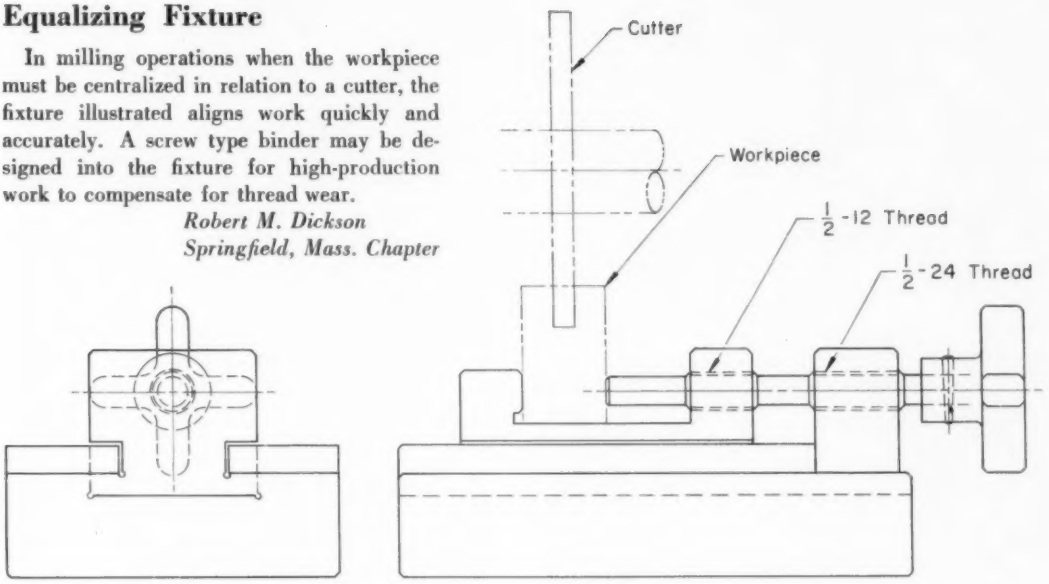
Gadgets

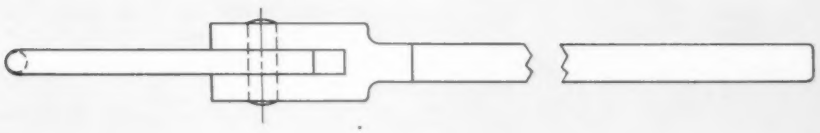
Ingenious Devices And Ideas To Help The Tool Engineer In His Daily Work

Equalizing Fixture

In milling operations when the workpiece must be centralized in relation to a cutter, the fixture illustrated aligns work quickly and accurately. A screw type binder may be designed into the fixture for high-production work to compensate for thread wear.

Robert M. Dickson
Springfield, Mass. Chapter

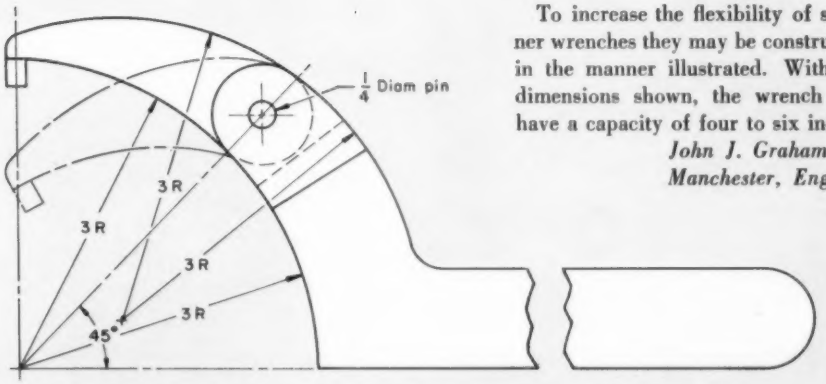


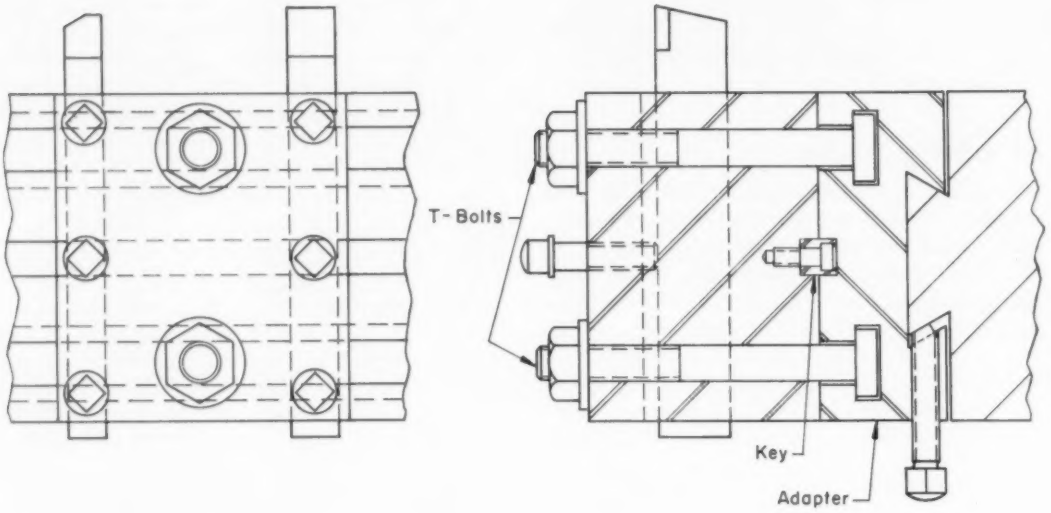


Spanner Wrench

To increase the flexibility of spanner wrenches they may be constructed in the manner illustrated. With the dimensions shown, the wrench will have a capacity of four to six inches.

John J. Graham
Manchester, England





Dovetail Adapter

On automatic lathes with multiple tool blocks, it is often desirable to remove the entire block for resharpening and resetting of the cutting tools. In such cases, the block is usually replaced with a duplicate to avoid a prolonged machine shut down. However, if there are more than two blocks in the setup, one or more of the end blocks must be slid off the dovetail in order to remove the ones in the middle. This is a time-consuming procedure.

Illustrated is a simple method of overcoming this difficulty without sacrificing accuracy or rigidity. An adapter, constructed from heat-treated steel, is made for the full length of the machine dovetail slide. A female dovetail is machined on the adapter the full length to fit the male portion on the machine. A keyway is milled in the center and two T-slots are machined parallel with the keyway. All tool blocks are then made with a key and drilled holes to receive standard T-bolts. To remove any block in the setup, all that is necessary is to remove the holding nuts from the T-bolts, lift the block off and put another one in its place. No other block in the setup is moved.

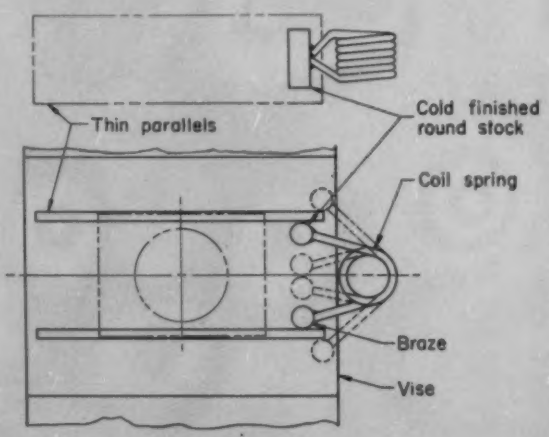
Roger Isetts, Kenosha, Wis.

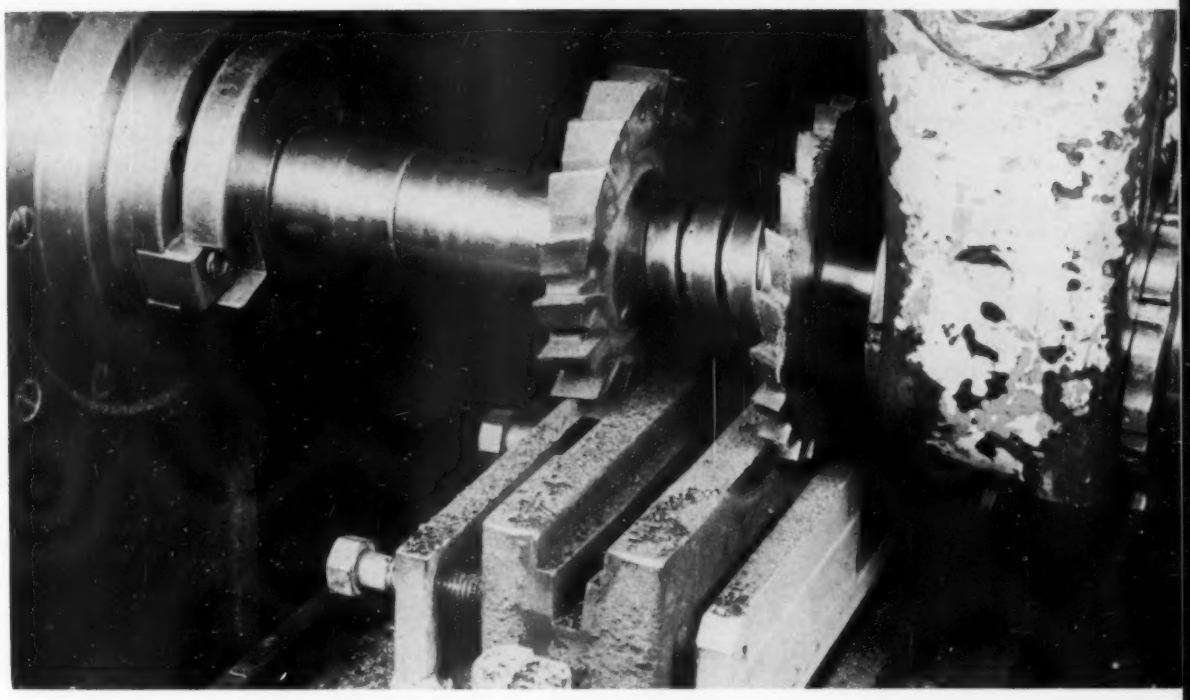
Parallel Spacer

During drilling operations, it is sometimes necessary to use very thin parallels to support the workpiece in the machining vise. These parallels are likely to fall over or tip while in use, with possible damage to drill or workpiece.

An effective way of avoiding this hazard is to employ the spring spacer shown. The spacer is made from a coil spring with a piece of round rod brazed to each end. The wide range of the spacer allows its use for a number of different workpiece widths.

Cliff Bossman
Dayton, Ohio



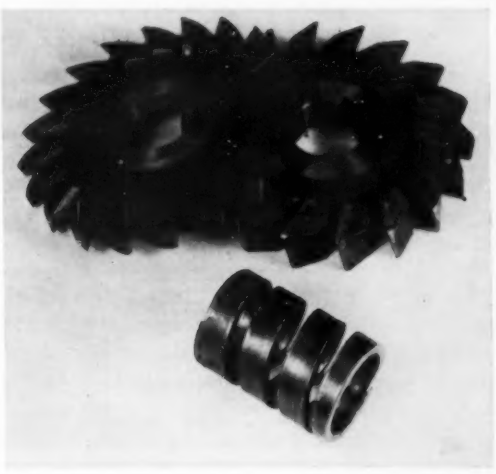


Spring Speeds Setup

When straddle milling a series of workpieces to different widths, adjustment of the distance between cutters can be time consuming. Placing a heavy helical compression spring between the cutters, as shown in the photograph, permits quick and easy adjustment of width. The adjustment, or change of width, is accomplished by tightening or loosening the nut on the end of the arbor.

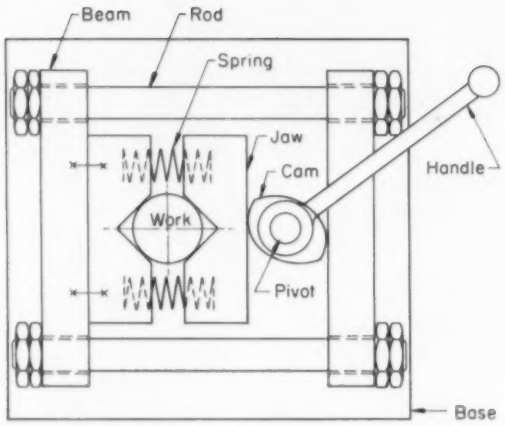
This arrangement has been successfully applied when milling operations were performed on a small lot of work, each piece of which had to be machined to a slightly different measurement for purpose of individual fitting. The method is also useful when several step cuts, each of different width, are required on the same piece.

Heavy duty springs are used. Standard die springs, cut to the required length, are suitable. Ends of the spring must be ground off square and, of course, the inside diameter of the spring must be of correct size to fit over the arbor.



For best results, the spring should be cut long enough to permit it to be placed under considerable initial compression before the cutters are set to position and before the cut is started. Measurement can be made by taking trial cuts or by direct measurement between the cutters, using an inside micrometer or vernier caliper.

H. J. Gerber
Member-at-Large



Self-Centering Fixture

Milling small, round workpieces of different diameters where centering under the cutter is required can be accomplished easily and quickly with the fixture illustrated. Essentially a vise, the fixture has two movable jaws which are held apart by springs when the fixture is open. The device is closed by means of a cam. The cam is double eccentric; one face pushes directly on one jaw and the other face pulls the other jaw by force on two beams and two rods. The jaws ride on guides and when closing, since equal force is exerted on each jaw, the workpiece is centered.

Federico Strasser
Santiago, Chile

Retractable Punch

Often stampings for left and right-hand parts differ only in the number or location of punched holes. Removing the punches is time consuming and loose punches are likely to be misplaced. Illustrated is a die design which allows a punch to be retracted if it is not to be used on a particular operation.

A key backs up the punch in normal operation. When it is desired to pass the part through without punching a hole at that point, the key is moved to a new position. The punch is then free to float in the retainer and will not pierce the metal. Chamfers on the punch and key allow the key to be returned to the normal operating position easily.

Edwin H. Stock, Afton, Mo.

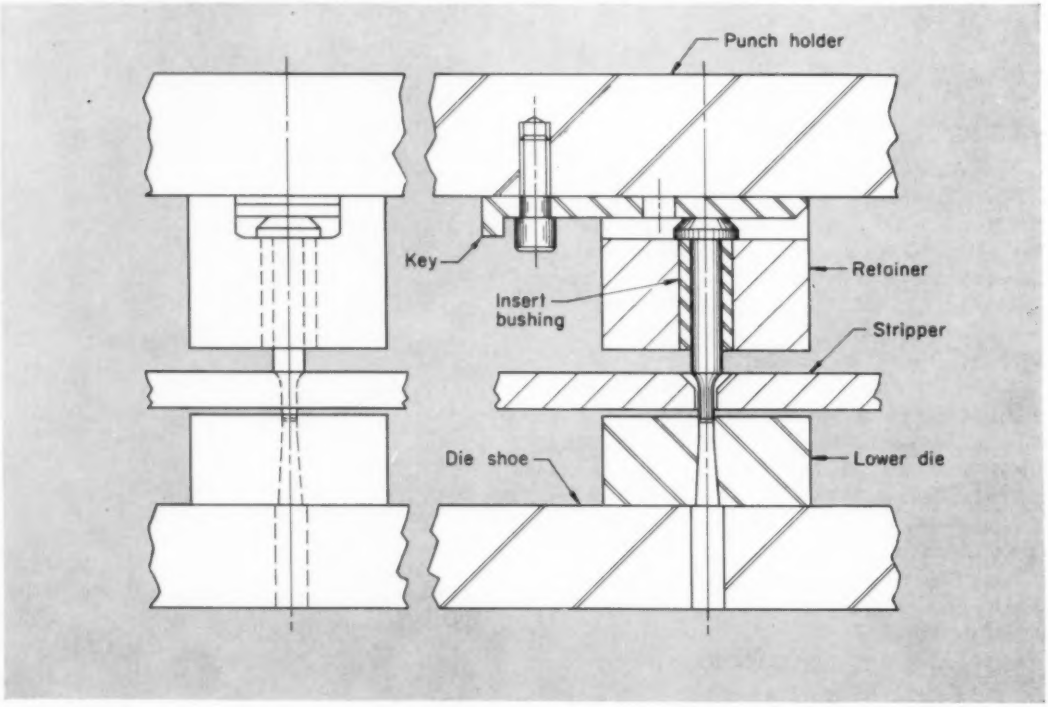


Fig. 1. Setup for straightening typewriter rails. Straightening fixture is at a convenient height; checking fixture is directly in front of operator.

Parts Straightening ... how to improve efficiency

By R. L. Jones

Associate Engineer
Tool Engineering
International Business Machines Corp.
Poughkeepsie, N. Y.

Hand straightening of small precision parts is often a necessity. Time spent in studying and improving straightening methods pays off in increased efficiency.

Abstracted from Paper No. 222 "Hand Straightening of Small Parts," to be presented at the 27th ASTE Semiannual Meeting. Copies of the complete paper are available for purchase from Society Headquarters.

STRAIGHTENING OPERATIONS fall into several categories. To straighten a part may mean to flatten it within predetermined limits. It may also mean to square up or correct parallelism between two or more surfaces. "Hand straightening" means, simply, that the operation is performed by hand rather than by machine or an automatic process, *Fig.* 1.

At plants making business machines, thousands of small parts must be held to very close dimensional tolerances so that the parts, when placed together into an assembly, will function properly as a whole. Straightening may be necessary to:

1. Make fine adjustments that cannot be obtained by machining
2. Adjust hole location tolerances
3. Permit certain machine operations to be performed
4. Correct for flatness, parallelism, alignment, or twist

5. Improve fits
6. Correct contours.

Eliminating Straightening Operations

Since each part must be handled individually, it is readily evident that hand-straightening operations are costly and time consuming. There may be situations where the cost of straightening a part exceeds the cost of the raw material and all the machine operations for the part. To reduce this cost, there are several steps which can be taken either to eliminate the operation or to simplify and speed it up.

The first step in the elimination of hand straightening is a thorough review of design of the component part and the assembly into which it fits. For component parts it is often found that straightness, within certain limits, can be ignored and deviations corrected at the assembly stage. It may be found that tolerances are unnecessarily close and that they can safely be increased, thus eliminating the straightening operation.

It is often said that if a part must be straightened by hand, there is something wrong with the previous machine operations. This is partially true and the fact that hand straightening becomes necessary may be attributed to worn machine tools, inadequate fixturing, dull cutting tools, or a host of other

Fig. 2. Improved workbench. Circular shelves swing out to hold pans of parts within easy reach of operator. Surface plate used for checking is at eye level.

reasons. A second step in the elimination of hand straightening is to improve machining conditions.

The third step in the elimination of hand straightening is to take advantage of commercially available tools that will perform the operation either automatically or semiautomatically. Some of these tools are:

1. Servo-operated hydraulic arbor presses
2. Roll straighteners
3. Patterned or rigidizing dies, sometimes called "dinking dies."
4. Roller hearth furnaces.

The use of rigidizing dies is not new to industry. In theory a series of formed points will upset the surface area of a part, tending to strengthen, as well as flatten, such areas. The distance between two points in a pattern is held to about 1 to 1½ times the stock thickness. Points are ground to a 60-90-deg angle and flattened on top so that they have an area of about 0.002 square inch.

In roller hearth furnaces, parts to be flattened are sandwiched in a fixture consisting of two steel plates about one inch thick. The fixtures are then placed on a carrier grid and the whole cycled through the furnace at 1700 F. Cycle time is 1½ hours at high heat and 6 hours for cooling, or a total of 7½ hours. Each carrier will hold 500 lb and the furnace has a capacity of 1000 lb per hour. The furnace uses exothermic gas to prevent oxidation. A flatness of 0.005 inch for the first three inches can be readily maintained. For each additional inch the tolerance of flatness must be increased by 0.001 inch.

Improving the Setup

Even after these first three steps in the elimination of hand straightening have been completed, there are still some parts that have to be straightened by hand because their dimensional tolerances are outside the capabilities of a machining process. Every machining operation, no matter what it is, has its limitations for accuracy. Step 4, therefore, does not consider the elimination of hand straightening but includes ways and means by which the hand operation can be made faster and easier.

At this point the tool engineer is no longer working with machine tools but rather with individuals who are performing a monotonous operation by hand. Hand straightening is an art and proficiency is acquired only after long experience. It requires experience to know where and how hard to hit a part to straighten it the required amount. Some knowledge is essential in the proper selection of hand tools. In addition, the training of a worker to become proficient at hand straightening is made difficult since there can be no written instruction on the subject. It is most important, therefore, that each individual be consulted for his ideas and opinions. When the worker is consulted he becomes more susceptible to new ideas and long standing habits are more easily broken.

An improved working environment is a good first objective and is one which most workers first suggest. Studies have shown that the ideal location for a department engaged in performing hand-straightening operations is one that is isolated from machining areas and is relatively clean and quiet. Of

primary importance is the improvement of lighting conditions, since the principal complaint from workers is excessive eyestrain.

Until about three years ago, straightening operators worked in small enclosures designed to exclude all glare from nearby light sources. Illumination was furnished by a single fluorescent light behind the surface plate. Eyestrain was common.

In designing a new straightening department, the enclosures were eliminated and overhead lights of the indirect type were installed giving a subdued lighting effect to the whole department. Secondly, all outside windows were equipped with venetian blinds to exclude daylight. The final step was to alter the color scheme in the department. A pastel shade of green was selected since this color has been proved to be restful to the eyes.

With the objective of improving lighting conditions still in view, attention was next given to the light source behind the surface plate which is necessary for hand-straightening operations.

The ideal light source should have several important features to satisfy the requirements of different workers. The intensity of the light should be adjustable; as should the shade or color of the light. The amount of visible light should also be adjustable.

With the booths or enclosures around the workbenches eliminated, and with the lighting improved, attention was next given to the workbenches themselves. Special features incorporated into the newly designed workbenches may be seen in *Fig.* 2. Two swing-out shelves are provided on which pans of parts may be placed so that they are within easy reach of the worker. The surface plate, which is mounted in an angle-iron frame, is adjustable for both height and angle of tilt, *Fig.* 3. Hand tools on the bench are readily accessible. Storage space for hand tools is provided in drawers.

It was found that some workers prefer to have the surface plate located at the level of the bench top. This arrangement has the advantage of permitting the worker to check his work at arm level. It is less tiresome and more efficient, especially where small parts are being straightened.

In addition to a workbench of improved design, new chairs reduce operator fatigue. They are tubular steel, fully adjustable, and have plastic-covered, foam-rubber seat cushions.

The goal of simplifying or speeding up straightening operations can more easily be met by furnishing the worker with the best available working tools and gages for checking his work. It is in this area that the tool engineer can use his ingenuity in improving existing tools or in designing and building new tools.

Some tooling that may be used for checking hand-straightening operations is:

1. Set pin gages
2. Drop gages
3. Functional gages, which simulate the function of a part in an assembly
4. Optical gaging and bench type contour projectors.

For some parts the straightening operation can be speeded up by providing a holding fixture to secure the part while it is being straightened. It may be found that the part can be left in the holding fixture while it is checked for parallelism or alignment with a height gage. In some cases a combination holding fixture and set pin gage can be provided. The periodic inspection of this type of tooling is essential. At IBM gages are inspected monthly for wear and proper dimensional tolerances.

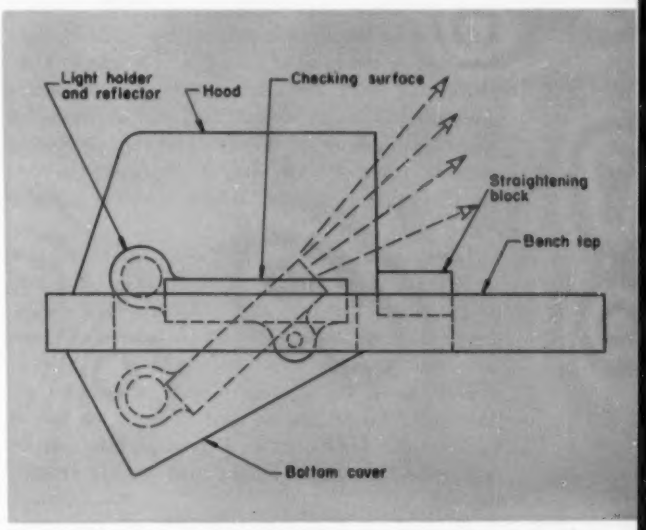


Fig. 3. Schematic drawing of flush-mounted surface plate. The checking surface is adjustable to eye levels from 4½ to 21½ inches above bench level.

New Checking Methods

A specific example of new types of tooling that can be developed is a gage utilizing miniature phototubes to measure the degree of straightness of typewriter rails, *Fig.* 1. Natural light does not affect the accuracy of the gage and the worker no longer need to look at a light source. This feature can be a large factor in relieving eyestrain. The inspection operation formerly required 2 hours per 100 pieces for the 12-inch rails and 3.4 hours per 100 pieces for 16-inch rails. Using a worker who was not familiar with the gage, the first day's production was increased to 1.4 hours per 100 pieces for the 12-inch parts and 2.8 hours per 100 pieces for the 16-inch parts. With added experience on the part of the worker, the time required for straightening should be cut in half.

Basic design and construction of the gage is as follows: A straightedge, approximately 1/16 inch wide and 18 inches long, is mounted in a vertical position on a frame. Four step blocks support the part while it is on the straightedge. Behind the straightedge five light sources are mounted, spaced 3½ inches apart and with their light beams focused across the straightedge.

In front of the straightedge, and opposite the light sources, are mounted five photoelectric tubes about three inches away from the light sources. Each phototube has its own relay which, when activated by the light beam, triggers a panel light mounted on the front of the gage. All light sources, phototubes, relays and related electronic components are assembled as an integral unit and are protected against damage or shock. Straightening equipment such as arbor presses, etc., is physically isolated from the gage to prevent distortion of the straightedge.

The spacing between light sources and phototubes is determined by the size of the part. In the case of the typewriter rails the spacing is 3½ inches. Length rigidity of the rails was considered sufficient to permit a fairly wide spacing. For shorter or thinner parts, the spacing should be reduced accordingly. Lucite can be used to bend the ray of light from a light source. Extending lens systems will spread the rays of light over a wide area, if desired.

The following procedure is used for setting up the gage: From the part print, the tolerance to which the part is to be straightened is determined. For illustrative purposes, 0.004 inch will be used. A small piece of 0.004-inch thick steel shim stock is placed on each end of the straightedge being careful not to have the shim stock opposite a light source. Furnished with the gage is a heavy straightedge for setup purposes. The straightedge is placed on top of the two pieces of shim stock. This creates a gap of 0.004 inch between the two straightedges, which is equivalent to the total tolerance to which the part is to be straightened.

Beneath each indicating light on the panel in front of the operator is a recesssed, slotted setscrew. With a screwdriver, the setscrew is turned clockwise until the panel light comes on. Then the setscrew is turned counterclockwise until the panel light turns off.

When this adjustment has been repeated on all five panel lights, the gage is set up to check a part to a flatness tolerance of 0.004 inch. The heavy straightedge and the two pieces of shim stock are then removed. Once the gage is adjusted for the desired tolerance, it is very stable and is unaffected by normal operating shocks. Surges in line voltage affect the sensitivity of the phototubes; therefore, a voltage regulator is used.

The procedure for straightening a part is as follows:

1. Place part on the straightedge in the gage
2. Glance at panel and if one or more of the panel lights are on, the section of the part directly behind the light must be lowered
3. Remove part from the gage, place it in an arbor press and bend at the desired point
4. Place the part on the straightedge and once again observe the panel lights.

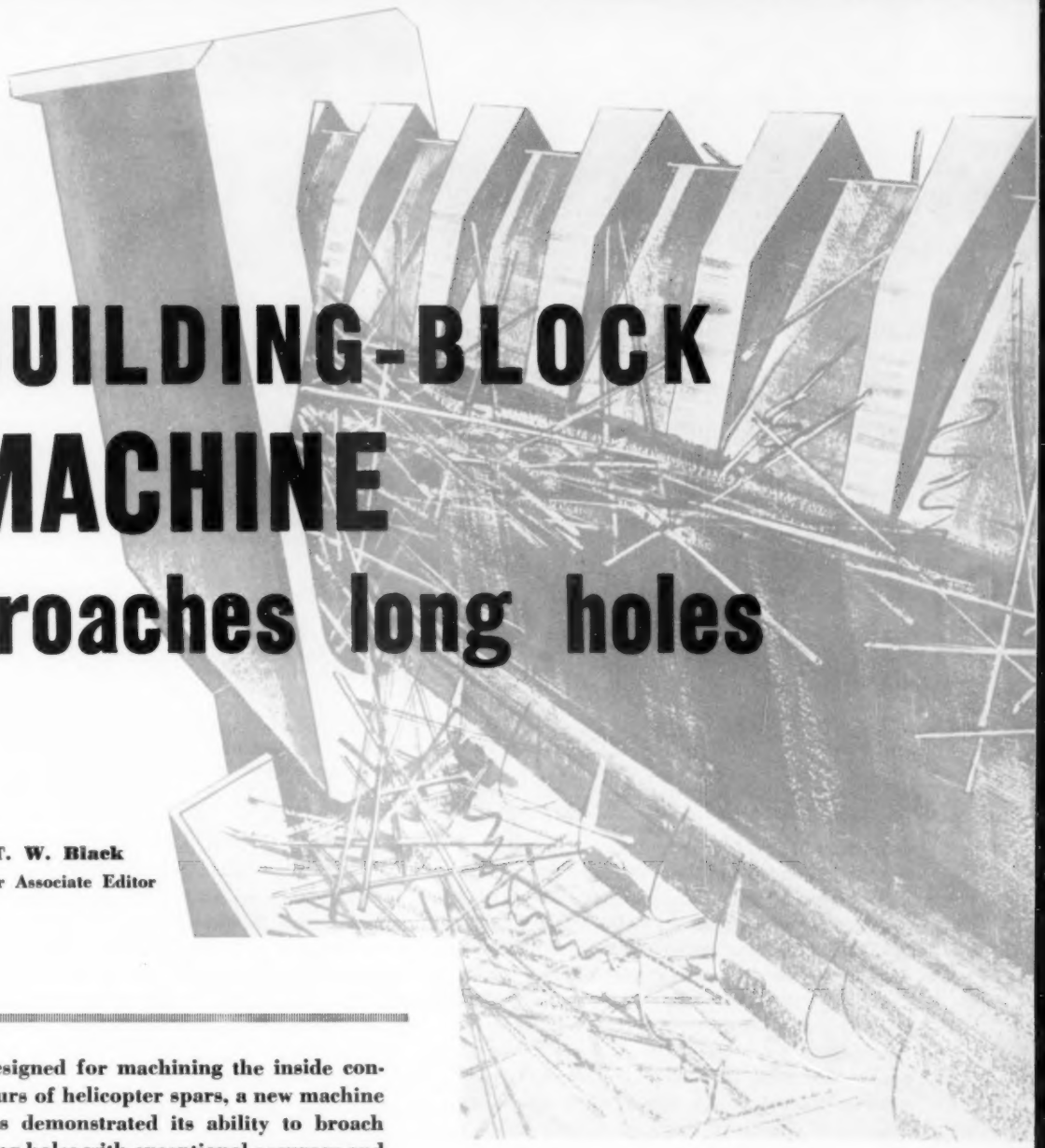
This procedure is repeated until all five panel lights are off when the part is resting on the straightedge. When this condition occurs, the part is flat within blueprint tolerances.

The phototube gage is limited to checking those parts which are in the shape of a bar or rod. It is not possible to check flat parts because they may have twist in them, and this deformity in a part cannot be detected. IBM has experienced with several prototype electronic gages which will detect the degree of flatness. This may be done by using, singly or in combination, magnetic pickups, electroproximity pickups, proximity transducer systems, metal film gages, or dynamic micrometers.

A visual measurement of flatness tolerances can be made through the use of read-out tubes which can be incorporated into the circuit. For the time being this type of gaging is not being used because of its high cost.

Since 1954, considerable effort has been expanded in attempting to automate straightening operations. On the basis of current experiments it can be said that automated straightening operations may not be an impossibility, but they are a long way from reality at present. Improvement of existing operations is still the most logical way to improve straightening efficiency.

"Haggerty, sometimes I think you don't take your work seriously."



BUILDING-BLOCK MACHINE broaches long holes

By T. W. Black
Senior Associate Editor

Designed for machining the inside contours of helicopter spars, a new machine has demonstrated its ability to broach long holes with exceptional accuracy and speed. Building-block construction of the machine base makes it possible to lengthen the machine to accommodate future, longer workpieces.

REQUIREMENTS of the aircraft industry for aluminum parts of unusual size and precision have resulted in the development of a number of machine tools that have considerably extended the range of existing machining processes. An example is a 64 foot horizontal broaching machine now being readied for delivery to Kaman Aircraft Corp.

The workpieces broached by this machine, which was designed and built by the Lapointe Machine Tool Co., are the spars or blades that provide lift for large helicopters. These are machined from long, hollow extrusions. First the inside contours are broached, then material on the outside of the extrusion is milled away to generate the characteristic airfoil shape. Approximately 600 pounds of metal are removed from the 700-pound extrusion to create a completed spar.

Since the work material is a tough 4153 aluminum alloy which, in the extruded form, has occasional hard spots and inclusions, machining is considered rather difficult. Internal broaching operations, in particular, are complicated by the tendency of the material to form long, stringy chips that can

Fig. 1. (above) Broaching machine with workpiece in position. A broaching pass has just been completed.

Fig. 2. (left) Internal contours of aluminum extrusion are finished with a series of broaching tools. Here a broach has just finished a pass.

cause difficulties when broaching long holes.

Machining of the inside contour is necessary to remove an oxidized layer left by the extrusion process. Machining also improves fatigue strength of the part by relieving stresses resulting from the extrusion operation and makes it possible to attain uniform wall thickness in the completed spar.

About one-eighth inch of stock is removed during the broaching operation. Engineering design requirements call for a 30-microinch finish and straightness must be held within ± 0.005 inch.

During initial studies, it was apparent that no existing machine had the necessary capacity to accommodate such long parts and to satisfy the stringent accuracy and surface finish requirements. Further, because of the constantly increasing size of helicopters, it was extremely desirable to provide a means for increasing the capacity of the machine when necessary. Low manpower requirements and high machine productivity were, as always, considered to be basic design requirements.

The resulting machine, *Fig.* 1, represents over two years of development work. Basically it is a horizontal pull broach with a 340-inch stroke. It is powered by a 50-horsepower electromechanical drive. This drive provides a steady pull on the draw bar during broaching and also returns the draw bar to the initial position after completion of each broaching pass. The machine is capable of broaching at speeds up to 80 feet per minute.

A series of eight clamps holds the spar in position for broaching. All clamps can be tightened to insure straightness. With a workpiece of this size and type, it was not considered feasible to rely on the tendency of a broaching cutter to center itself as it is pulled through the spar; hence the emphasis on heavy, adjustable fixturing.

Because of the large amount of stock to be removed and the length of the spar, over 30 separate passes are made to complete each part. Each pass is made with a separate broach, *Fig.* 2. The cutters are high-speed steel, designed as inserts that are mechanically fastened into toolholders. Use of these inserts results in much lower tool costs than would be possible with solid high-speed steel cutters, since the holders can be made of relatively low-cost alloy steels. Each tool is numbered in sequence so that the operator should have no trouble in performing successive operations in the correct order.

All broaches are stored on a conveyor that carries them from one end of the machine to the other. Tool changes are facilitated by two hydraulically actuated hoists. A hoist at the front end of the machine lifts a tool from the end of the conveyor and swings it into position in front of the

Fig. 4. After completion of pass, broach is detached from draw bar, then hoist swings it into position on the broach conveyor.

draw bar. Similarly, a hoist at the other end of the spar removes each broach after completion of the pass and deposits it on the conveyor.

The conveyor is of the over-and-under type. Wooden blocks, attached to the conveyor chains, hold the tools in position. Use of wood eliminates the possibility of damage to the teeth while the tools are being loaded onto the conveyor. The conveyor motor is linked to the machine control so that it indexes a new tool forward with each machine cycle. Thus the correct tool is always in position at the end of the conveyor when it is needed.

Use of the conveyor has, of course, greatly cut down on the amount of time that would otherwise be required to handle and change tools. Another way in which machine productivity has been increased is through the use of a small electric truck that carries the operator between the two ends of the workpiece. This truck is, in effect, a traveling platform that enables the operator to be in position to attach or remove tools without any delays. It is doubtful whether an operator could walk fast enough, long enough, to keep up with the pace of the machine over the course of an eight-hour working day, so the moving platform represents an important means of keeping machine productivity at high levels.

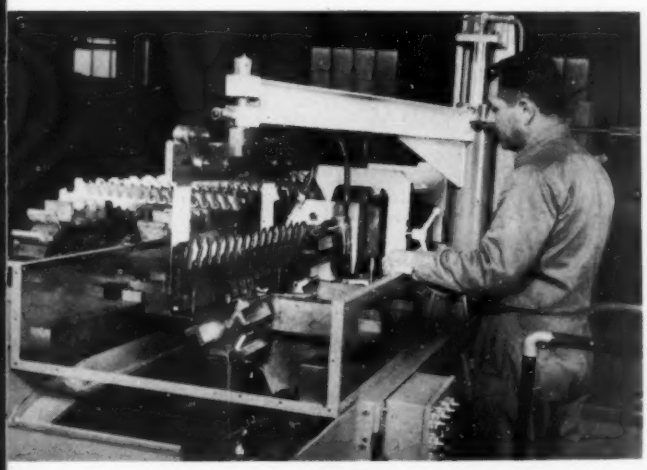


Fig. 3. Hydraulic hoist removes broach from conveyor, places it in position for attachment to draw bar.

The cycle of operation is as follows: first the operator, using the hydraulic hoist, takes a broach off the conveyor and attaches it to the draw bar, which is in position in the spar, *Fig.* 3. Next the operator presses the start button and the broach starts its travel through the spar. During broaching, the operator travels to the other end of the spar on the moving platform. When broaching is completed, he disengages the broach from the pull bar and, again using a hoist, positions it on the conveyor, *Fig.* 4. He also cleans chips from the broach and the end of the part as necessary. After pushing a control button that starts the pull bar on its way back through the spar and causes the conveyor to index, the operator and moving platform return to the initial position to start a new cycle. Automatic stops keep the platform from traveling too far in either direction. Two rails, running parallel to the side of the machine, keep the platform in correct alignment.

Coolant for the operation is pumped through passages in the draw bar, providing a copious flow at the broach. The coolant is a sulfur-based fluid, compounded especially for the job. A coolant filtration and recirculation system is used.

The machine base is built up from a 40-foot center section and two 12-foot end sections. If it becomes necessary to broach longer spars, only new end sections would have to be added.

Results with the new machine have been excellent to date. Required tolerances are held without difficulty. Total floor-to-floor time per spar is about two and one-half hours. It is estimated that this total time will decrease as production experience is gained.

designed for

PRODUCTION

Positive Torque Control for Nutsetters

TORQUE CONTROL IN the operation of air powered tools is important in obtaining quality assemblies with fasteners. By use of a special clutch in a nutsetter developed by Cleco Div. of Reed Roller Bit Co., the air supply to the tool is shut off when the predetermined torque is obtained.

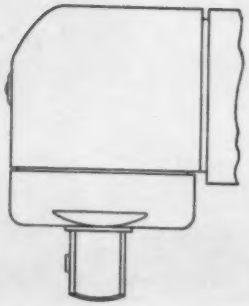
To operate the tool, the throttle valve lever is depressed to move the latch body assembly and open the throttle valve. Until shut off automatically, the throttle valve lever of the tool is held depressed during the run-down cycle. Movement of the latch body is transmitted to the throttle valve by a latch which is held in engagement with a shoulder throttle valve by a rubber spring. Automatic closure of the throttle valve is effected by the clutch when, with the tool running, the driving spindle reaches the preset torque through compression in clutch torque spring. When the required torque is reached at the driving spindle, it is transmitted back to the pinion spindle causing the hexagonal portion of the pinion spindle to overcome the force exerted against it by the torque spring during rundown.

The torque spring acts through the ball retainer and balls which normally rest against the hexagonal flats. When the balls climb to the hexagonal crest, the ball retainer is forced toward the motor and

—Photo courtesy Cadillac Motor Car Div.

STALL TYPE pneumatic wrench being used to install a body bolt in a luggage compartment.

SCHEMATIC diagram of air-operated nutsetter showing details of torque clutch and release mechanism components.



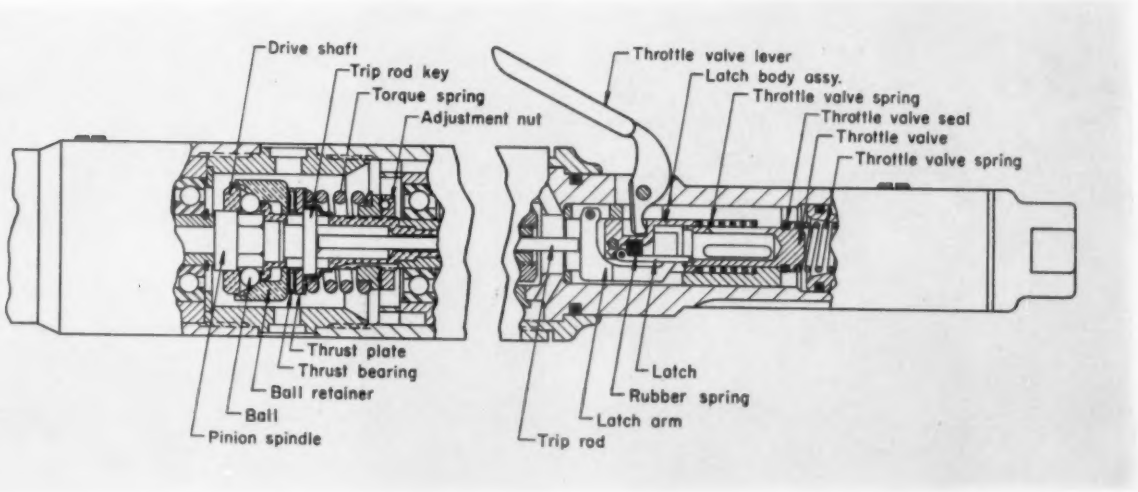
BODY BOLTS being installed on the under side of an automobile to attach the body to the chassis. Location of the fastener requires a tool that is light in weight and easy to actuate as well as control.

transmits the motion through the thrust bearing and plate. This action moves the trip rod key to push the trip rod against the latch arm.

When the throttle valve is open at the start of the run-down cycle, a throttle valve spring is held under compression. The spring tries to close the valve but it is held open by the latch against the shoulder in the valve and is maintained in this position by the lever being held down.

When the preset torque is reached, this condition changes and the automatic closing occurs when the trip rod has been urged against the latch arm. This motion pivots the arm about its trunion and bears against the latch. The latch moves out of engagement with the shoulder in the valve. This action permits the spring to return the throttle valve to the closed position although the throttle valve lever is still held in the operating position. Torque setting is controlled by an adjustment nut. This nut may be screwed in or out to increase or decrease compression on the torque spring.

—Photo courtesy Cadillac Motor Car Div.



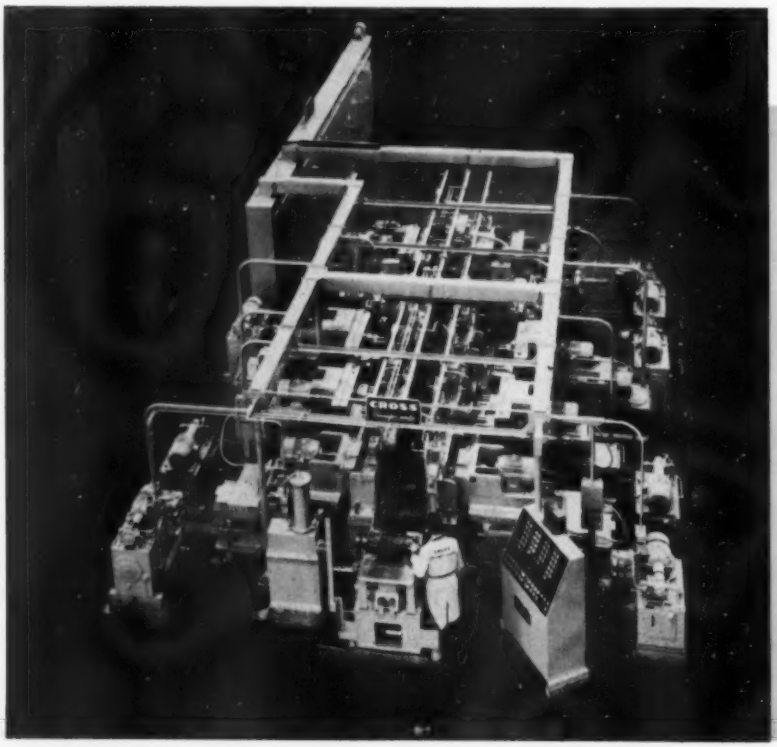
Transfer Machine for Multisize Castings

VERSATILITY IS OBTAINED in a transfer machine when a number of different products can be processed over the line with only minor changes of the existing machines. Such versatility and adaptability is possible in a transfer machine developed by Cross Co. for the machining of aluminum or cast-iron cylinder heads.

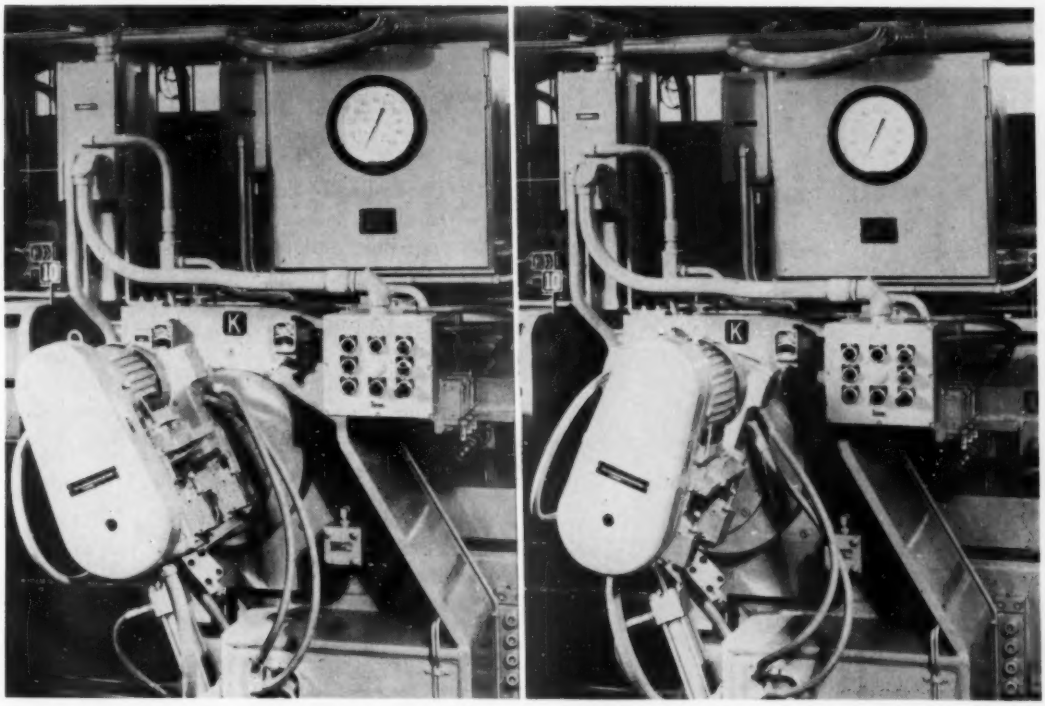
Heads being processed through the machine range in length from 12 inches to 24 inches in three increments. Machine setup for processing any of the three heads can be accomplished within four hours and primarily calls for relocation of fixtures in machine units. The relocation is accomplished by tie rods that connect the fixture to the machine unit. The machine unit is advanced or withdrawn to position the fixtures to accommodate the head being processed. When in position dowel pins are inserted manually into locating holes in each side of the fixture base to locate the fixture for the new part.

Several of the stations that employ single spindle drill units, air test mechanisms or tapping heads permit the fixtures to be positioned by a manually controlled hydraulic cylinder. With minor changes in feed dogs and several tool changes, the machine is easily converted from processing any given head to another.

An interesting design feature is found in the application of two single spindle quill type drilling units on the machine. Each unit chamfers one end of two oil holes without reorienting the part. The drill unit is mounted on a revolving drum plate that swivels the unit automatically from the centerline of one hole to the other. After chamfering the first hole, the quill retracts and the unit is revolved by a cylinder until the spindle is aligned with the centerline of the second hole.

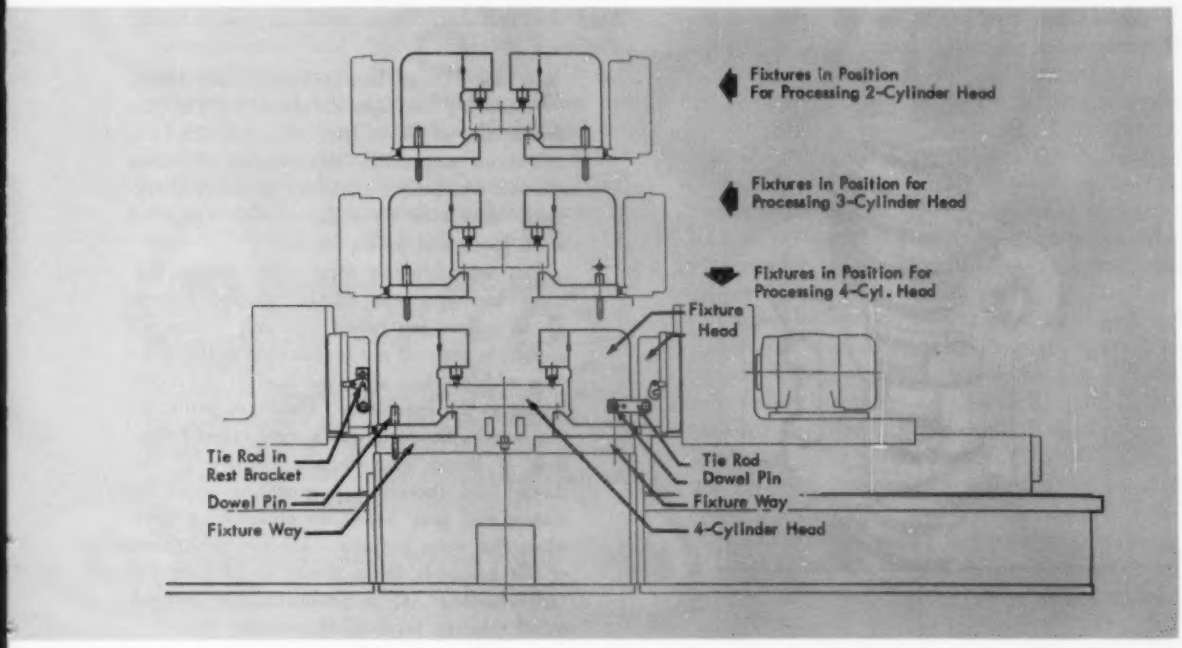


TRANSFER MACHINE for processing the ends of three different cast iron or aluminum diesel engine cylinder heads. The workpiece being processed is a four cylinder head casting.

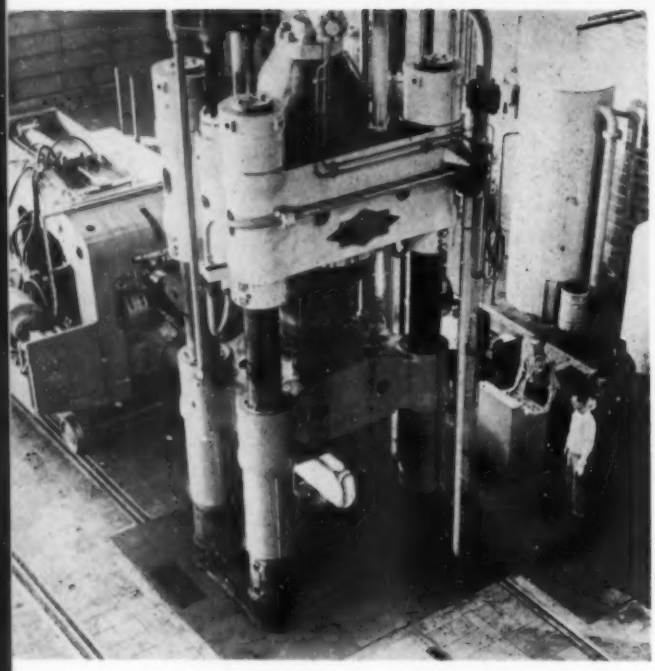


SINGLE-SPINDLE drilling unit mounted on a revolving drum plate to position chamfering tools from the centerline of one hole to the other when the part is clamped in the work station.

SCHEMATIC DIAGRAM showing the various positions for processing different size castings. Tie rod connection of head and fixture for repositioning are shown in right hand side fixture and on the left during rest.


Fixtures in Position For Processing 2-Cylinder Head
Fixtures in Position for Processing 3-Cylinder Head
Fixtures in Position For Processing 4-Cyl. Head
Fixture Head
Tie Rod in Rest Bracket
Dowel Pin
Fixture Way
Tie Rod Dowel Pin
Fixture Way
4-Cylinder Head

DESIGNED FOR PRODUCTION



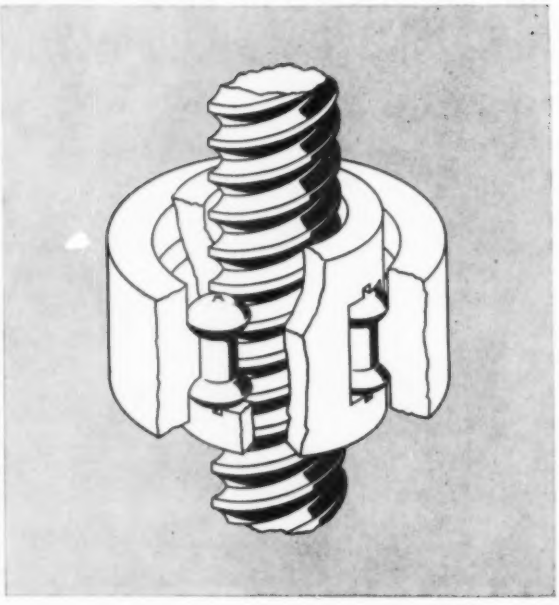
Forges Super Alloys

Water-hydraulic forging press minimizes the effects of deflection due to off-center loading. Forging super alloy billets at Haynes Stellite Co., the press, designed by Birdsboro Steel Foundry and Machine Co., handles billets in a weight range of from 1500 to 10,000 pounds. Fast-acting, it forges at the rate of 120½-inch planishing strokes per minute or 35 3-inch cogging strokes per minute. Two 600-hp seven-plunger pumps maintain pressure in the hydraulic accumulator system at 4500 psi.

The forging operation is invariably off-center up to three inches or more. Resulting deflection is minimized by heavy-duty tie rods as well as special tie rod nuts that assist in relieving bending stresses in the tie rods.

The press is operated from a main control console by one operator who has finger-tip control over planishing. The cogging, or main forging operation, is done through a manual control lever.

Bearing Screw Converts Rotary Motion into Linear



An antifriction bearing called the Roton bearing has been developed by The Anderson Co. of Gary, Ind. Designed into nut and screw assemblies, this bearing furnishes efficient conversion of rotary to linear movement—and vice versa for a wide range of work loads and power inputs.

The assembly has some novel design features including the dumbell-shaped rollers. These rollers are caged and roll within an annularly grooved nut functioning as the outer race with the helical thread lead of the screw acting as the inner race. Planetary action of the caged units results in a mechanical reduction of linear advancement relative to the thread lead, thereby supplementing speed reducers and gear boxes, or eliminating them when the ratio permits. Another advantage of the assembly is its ability to provide for "freewheeling" at a predetermined end of travel pending reversal of motion.

cast-to-shape Workholders . . . simplify tooling problems

By Richard Spoor*
Tool Engineer, Brownsburg, Ind.

Because of their irregular shape, many forgings and castings cannot be held in standard chuck jaws, collets, V-blocks and the like. Suitable workholders can be cast from low-melting-point alloys, using a workpiece as a pattern.

PRECISION of machined products is directly related to the workholding devices employed. Location points, gripping pressures, part deflection, and compressive loading of part and tooling are some of the factors to be considered in workholder design. The possibility of part distortion must also be taken into account.

Two basic types of material are used in workholding devices. These can be classified into "hard" materials—steel—and "soft" materials—plastics and low-melting-point alloys. Hard tooling is normally associated with high-volume production and soft tooling with experimental or low-volume production. During the past decade, however, soft tooling has gained considerable acceptance. Tooling costs are low, lead times are shorter than for hard tooling and tool life is good.

Casting Techniques: Cast-to-shape or "impression cast" workholders save time and labor. A part is used in reproducing the desired contour in the workholder. Metal-removal operations are not required to generate the contour and the low-melting-point alloys employed can be melted down and re-used when they have fulfilled their purpose. Most of these alloys have stable dimensional characteristics and sufficient tensile strength for workholding applications.

The impression casting process is quite simple. A split steel flask or mold with two symmetrical halves is used, *Fig.* 1. Dimensions of the flask correspond to the size of the part and tooling required. A suitable mold clamping arrangement is provided. A central bushing is incorporated into the bottom of the flask to receive the part and hold it in vertical position. One end of the part is turned and faced for insertion in this bushing.

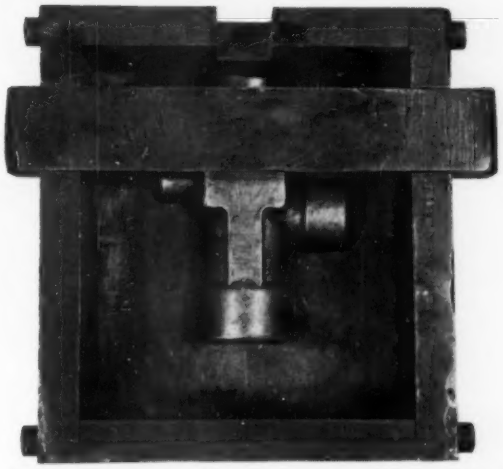


Fig. 1. Flask assembled for pouring an impression-cast workholder. An actual part is used as a pattern.

Prior to inserting the part in the flask, the surface is smudged with an acetylene flame or covered with a parting agent to facilitate removal after solidification. Next the flask is preheated and molten alloy is poured into place.

After solidification, the mold is unclamped and parted, and the casting, with the part intact, is removed. The turned diameter of the part that was inserted in the central bushing of the flask is then chucked and the OD and end of the casting is machined. The large turned diameter is then chucked and the opposite end of the casting is machined. These machining operations are followed by any machining that is required to adapt the casting to a chuck, vise or other holding device.

Once all machining operations are completed, the casting is cut into two halves and the part is

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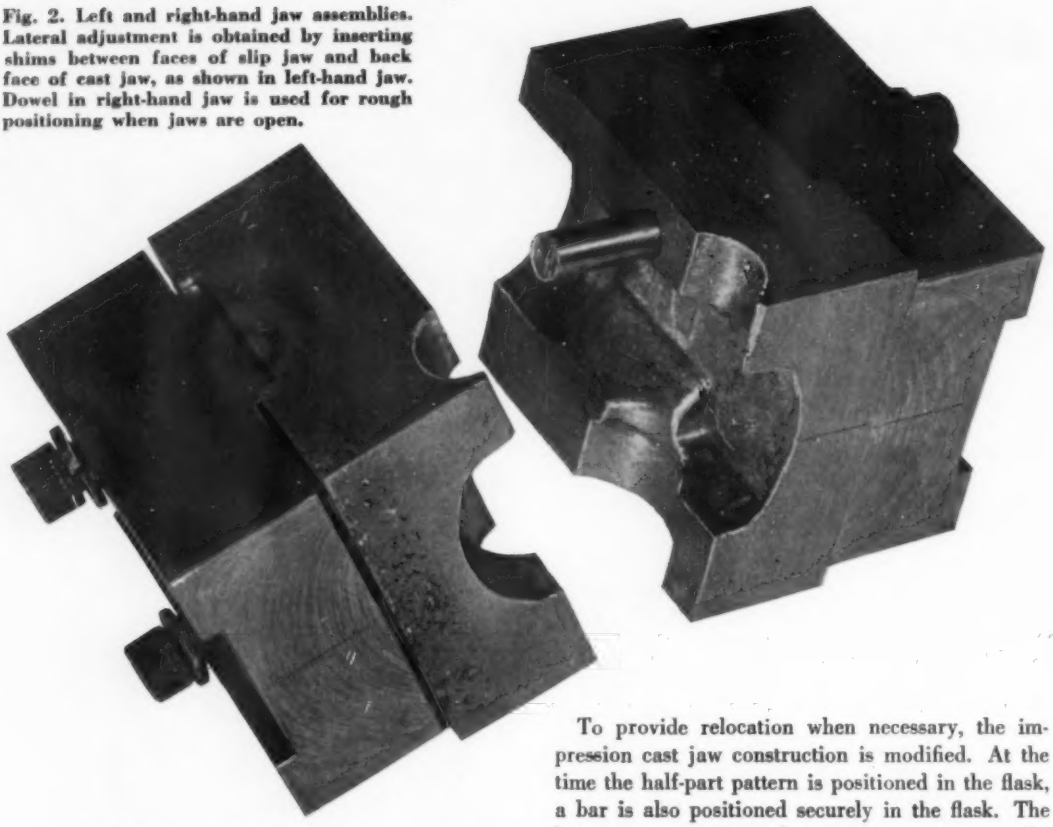
Fig. 2. Left and right-hand jaw assemblies. Lateral adjustment is obtained by inserting shims between faces of slip jaw and back face of cast jaw, as shown in left-hand jaw. Dowel in right-hand jaw is used for rough positioning when jaws are open.



removed. Relieving and hand-finishing operations complete the workholder.

This method was successfully applied to a battery of multispindle, tool-rotating chucking machines producing a variety of brass parts. The tooling costs associated with the program were high and further avenues of cost reduction were sought. A review of the method showed that economies in toolmaking labor and material could be realized if external machining of chuck jaws and slitting operations could be eliminated.

A new approach was conceived, utilizing the cope-and-drag pattern principle. With this method only one part, machined into two halves (right and left), can produce any number of chuck jaws. External machining and parting operations have been eliminated by using the half-part for a pattern and constructing the flask with internal dimensions and contours to match the external dimensions of the jaws required.

Slip Jaws: When identical parts are produced on several dies or patterns, variations exist because of "die wash" or pattern shifts. Often these variations affect the function or appearance of the product. Compensation must be made for these variations by relocating the part in relation to the work spindle—an impossibility with fixed-position tooling.

To provide relocation when necessary, the impression cast jaw construction is modified. At the time the half-part pattern is positioned in the flask, a bar is also positioned securely in the flask. The bar acts as a pattern for casting a groove in the jaw at right angles to the horizontal center line.

A steel "slip jaw" fits into the groove, *Fig.* 2. The purpose of the slip jaw is to provide both vertical and lateral movement, or a combination of these two movements. The tongue of the jaw is machined to fit into the groove and the opposite side is machined for adaptation to the master jaws of the workholding device. Vertical movement is obtained by means of elongated slots in the slip jaw; lateral movement is obtained by inserting shims between the faces of the slip jaw and the cast chuck jaw.

To insure proper endwise location with respect to a given reference point, the slip and cast jaws are placed on the master jaw of the workholding device and positioned from the reference point. Then the slip jaw is drilled and tapped. On multispindle machines, accurate positioning is particularly important; otherwise parts produced on different spindles may vary.

Adoption of impression-cast workholders has resulted in substantial savings. Soft tooling costs are approximately 40 percent of the cost of the hard tooling previously used. Chuck jaw life ranges from 60,000 to 110,000 parts. Thus the method is definitely suited for high-volume production; also for gage, fixture and jig tooling.

eliminating chatter in MACHINE TOOLS

By M. Sadowy
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Chatter problems cannot be resolved until basic causes are determined and analyzed. This should take place at beginning stages of machine structure design. The author explains methods to investigate chatter origin and a design approach to obtain chatter-free tools.

CHATTER is often encountered in machine-tool operation. Its elimination or prevention is a must to preserve product quality and prolong tool life. Sometimes, chatter can be eliminated by changing the processing conditions or by switching the operation to a sturdier machine. These are effective methods but do not resolve the basic problem. Studies reveal that chatter can be eliminated to a great degree by redesign of the machine tool.

Chatter Theory

The term "chatter" in this discussion designates self-excited vibrations in metal-cutting machines. These vibrations appear to have a characteristic frequency that is approximately constant in a given case. The excited amplitudes are usually very high —100 to 1000 times greater than the average. In most cases of chatter, a typical bulid-up of the amplitudes can be observed, *Fig.* 1.

Abstracted from Paper 215, "Chatter Vibrations as a Stability Problem of Machine Tool Structures," to be presented at the 27th ASTE Semiannual Meeting. Copies of the complete paper may be purchased from Society Headquarters.

Chatter vibrations, being in the category of self-excited vibrations, occur in dynamically unstable systems. They therefore can be considered as a stability problem of machine design—sometimes difficult to resolve in practice.

Despite various attempts to clarify and classify conditions governing chatter, the theory of chatter is still incomplete. The reason lies not only in the complexity of the chatter problem but also in the difficulties associated with establishing and comprehending meaningful characteristics and their relation to machine tools in operation. These difficulties are primarily due to limitations in measuring techniques and available instruments. For example, it is difficult to measure the angular and linear vibrations in rotating transmission parts.

Until recently, most investigations of chatter have been concentrated on the influences of the cutting conditions. It appears, however, that machine tool design is no less important. The influence of torsional vibrations in rotating transmission parts still seems to be disregarded. Some investigators are inclined to assume that there are no such influences or that they can be neglected in comparison with the vibrations of the machine-tool structure.

Various observations in shop practice, e.g., gear noise during chatter and in a few cases visibly large angular amplitudes of rotating transmission parts indicate that transmission parts contribute to chatter. This is also supported by theoretical considerations of the usually very low dynamic stiffness of transmission drives and of the cutting forces, the directions of which are mostly disadvantageous.

Vibratory Systems: A machine tool can be considered as a vibratory system usually having a complex dynamic behavior. Relative motion be-

tween the cutting tool and the workpiece during chatter results not only from deformations of the cutting tool and workpiece but also from the deformation of the entire machine. Usually, these deformations are most prominent when the machine tool vibrates with one of its natural frequencies, which happens with either resonant forced vibrations or free vibrations. The deformation of the machine at a given instant of maximum amplitudes determines the mode of vibration—the natural mode of vibration in the case of a free vibration. There is a close correlation between natural modes of vibration and natural frequencies.

The modes of vibration, the corresponding natural frequencies, and the damping effective at the particular modes of vibration determine the dynamic behavior of the machine. These values can be included under the term of dynamic stiffness, or dynamic rigidity. One of the objectives in testing machine tools is to determine these values.

Static and Dynamic Stability

A simple way to determine the stability of a mechanical system is to observe the motion of the system after having displaced its mass from the position of equilibrium. The system is statically stable if the displacement originates positive spring forces tending to restore the equilibrium position, *Fig.* 2. The system is statically unstable, *Fig.* 2, if it has a negative restoring force which supports the displacement. The criterion of static stability or instability is, respectively, the decreasing or increasing static displacement of the disturbed system.

The system is dynamically stable if the masses of such a system, originally displaced and then released, oscillate with decaying amplitudes toward the state of equilibrium, *Fig.* 3. A dynamically unstable system oscillates with growing amplitudes and thus deviates more and more from the state of equilibrium, *Fig.* 3. In both cases the systems vibrate at their natural frequencies. The observed vibratory motion is a free motion. In the dynamically stable systems damping is positive while in the dynamically unstable systems the effective damping is negative. The amplitudes of the dynamically unstable systems would reach infinite values if not limited by nonlinearities in the system. Systems can be stable at small disturbing amplitudes and become unstable at large disturbing amplitudes, *Fig.* 4, or vice versa.

Stability of Machine Tools: Although a machine-tool may be statically and dynamically stable in itself, it may become unstable by the action of

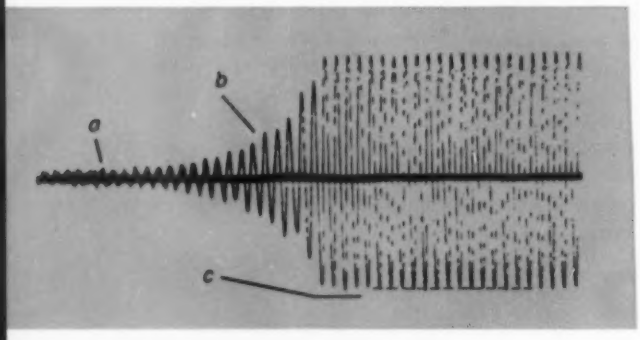
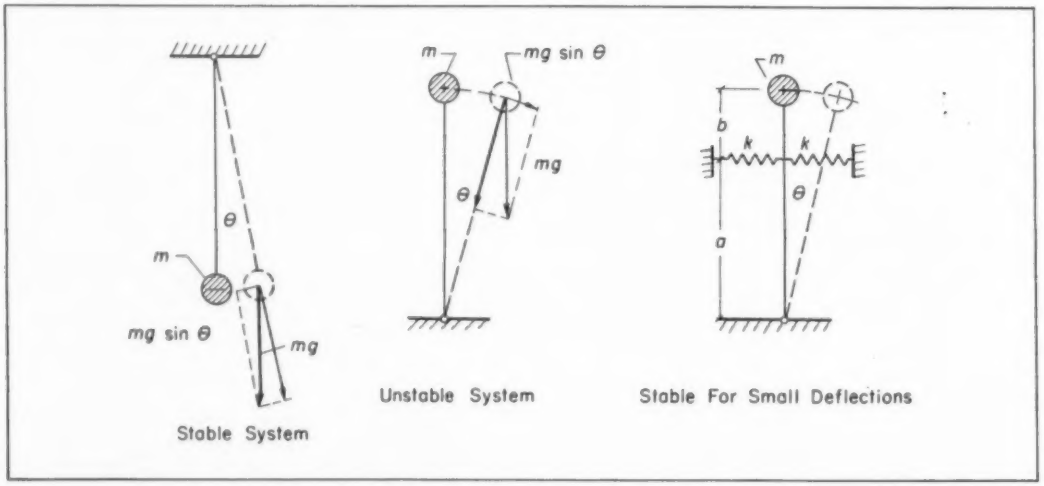
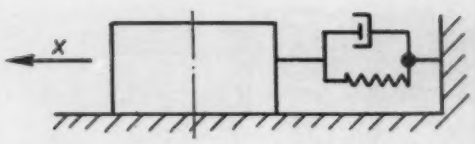


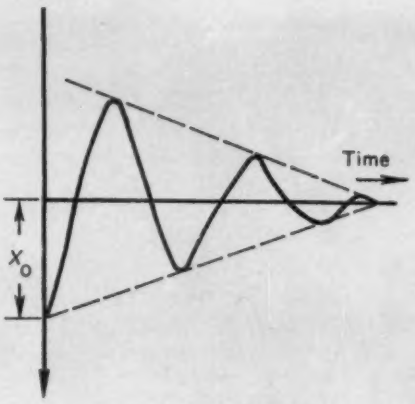
Fig. 1. (left) Horizontal amplitudes of a planer table building from the normal level of disturbing vibrations. At (a) is shown normal vibration level, at (b) is increasing amplitude, and at (c) is maximum.

Fig. 2. (below) Examples of statically stable and unstable systems. In the stable system, the deflection initiates a restoring force due to gravity. In the unstable system, gravity increases the original deflection. In the system stable for small deflections, the system becomes unstable for large deflections. Stability boundary condition: $(a + b)\ mg = ka^2$.

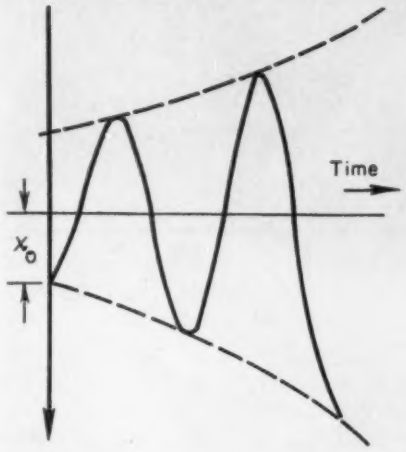




SYSTEM



STABLE SYSTEM



UNSTABLE SYSTEM

Fig. 3. Vibratory system including mass *m*, spring c and damping *k* can be dynamically stable or dynamically unstable, depending on whether an induced vibration is damped or not.

forces originating in operation, such as frictional and cutting forces. The machine structure becomes statically unstable, for example, when the cutting forces initiate deflections of the cutting tool that have a component in the direction of increasing feed or depth of cut. Because of this, the cutting forces are increased causing more deflection of the cutting tool. There is an unstabilizing feedback between the cutting force and the displacement of the cutting edge. Dynamic instability of machine tools can have two main causes:

1. The negative characteristic of friction developed between the moving parts of the machine tool
2. The cutting forces.

Instability in sliding can be observed when the friction characteristic between sliding parts becomes negative. That is, the slope of the curve obtained by plotting friction force versus speed of motion is negative. Normally continuous sliding changes then to a vibratory interrupted motion, generally known as "stick-slip." All sliding parts with relatively low velocity have a tendency toward these disturbances, especially when the moving masses are large and the stiffness of the drive and the internal damping in the system are low. Some reciprocating tables in grinding machines, carriages in heavy duty lathes, automatically controlled parts and precision positioning devices are typical examples of these systems.

The stick-slip disturbances can be approximated by a vibration of a simple system with a negative damping characteristic. These disturbances can be eliminated by changing the friction between the moving parts (difficult in many instances) by reducing the masses of the moving members, and by increasing both the stiffness of the drive and the damping in the system. In the latter cases, special measurements usually are necessary to determine the vibrating parts of the machine and to determine the dynamic characteristics of the system, such as the spring constant, masses and damping.

Instability in cutting is caused by the interaction between the cutting forces and the vibrations of the machine-tool components. From the theoretical point of view, various particular mechanisms of such interaction are possible. When disturbed, the machine starts to vibrate with its particular natural frequencies and with the corresponding modes of vibration. Usually these modes of vibration also include a relative motion between the workpiece and the cutting tool. If one or more modes become unstable, the amplitude of the motion changes the cutting conditions, increasing or decreasing the depth of cut, feed, or cutting speed. When these values are changing, the originally quasi-constant cutting force becomes alternating. It then can increase the vibratory amplitudes of the machine and also the relative amplitude between the cutting tool and the workpiece, which in turn builds up the magnitude

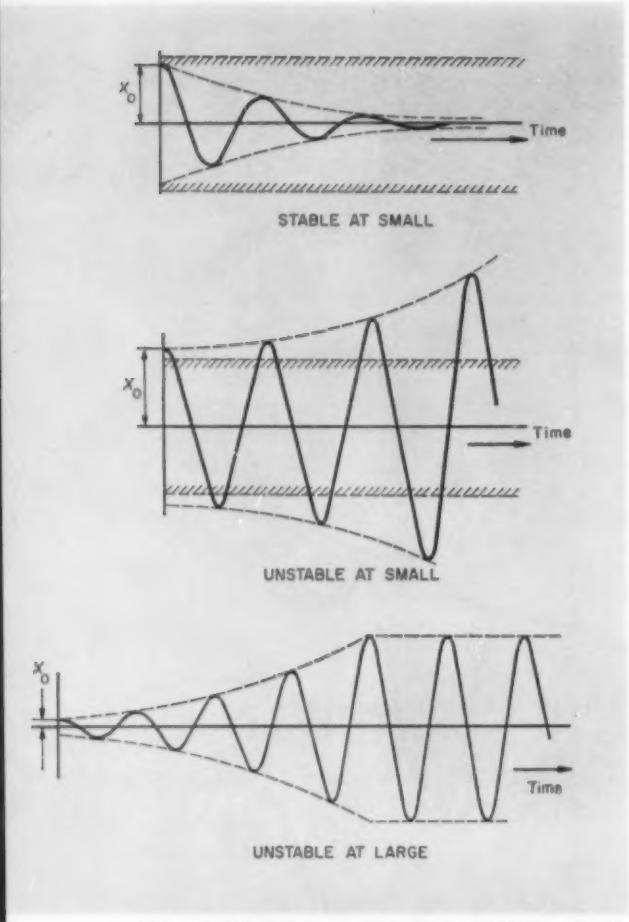


Fig. 4. Different cases of dynamic stability, depending on the magnitude of the original disturbance. Value, x_0 is original disturbance.

of the cutting force. The machine itself thus contributes to the progressive increase in chatter.

There is an unstabilizing feedback action between the cutting forces and the machine. The cutting forces can be considered as being controlled by the vibration of the machine and vice versa.

Experimental Investigations

Chatter experiments were carried out on the following machine tools: a lathe, a horizontal, knee type milling machine, a radial boring machine, and a planer. The investigations consisted of measurements of machine tool deformation under working chatter conditions and measurements of machine tool deformations under vibratory testing conditions, with the machine tool excited by a vibrator. Recording of the motion of the cutting tool and of the workpiece during chatter was accomplished with a high-speed camera. These camera studies revealed that on an average, the workpiece stands still for

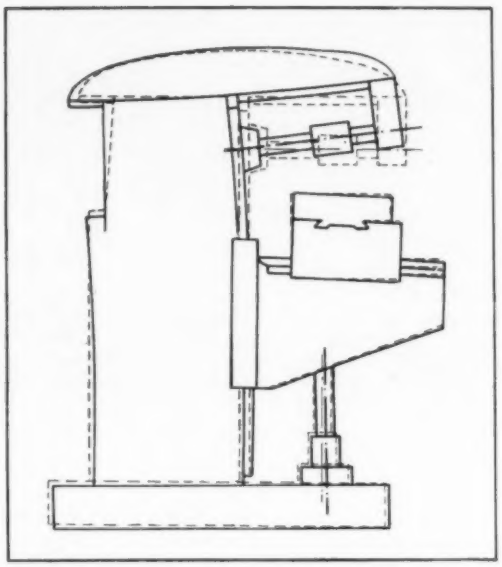


Fig. 5. Deformation of a milling machine working under chatter conditions. Frequency is 110 cps.

about 35 percent of each cycle of the chatter motion and at the same time the cutting speed is approximately zero. During the remaining 65 percent of each chatter period there is an acceleration and a deceleration of the workpiece. The latter can be accelerated to such a high angular velocity that the corresponding value of the actual cutting speed greatly exceeds the nominal cutting speed.

The deformation observed in chatter as well as the resonant modes of vibration were as follows:

Lathe: The chatter mode can be referred to as a mode in which the horizontal bending predominates. The same mode of vibration, excited as a resonant mode, shows not only bending of the lathe bed but also deformations in the tailstock and in the mounting of the workpiece. With the natural frequency of the mode being 108 cps and the chatter frequency being at 143 cps, there seems to be a relatively large difference in frequencies of the chatter and resonant mode. This difference can be explained by the coupling action between the vibrations of the machine bed and the transmission system. Hence, the chatter involves vibrations of the structure and of the transmission drive.

Milling Machine: In the chatter mode of vibration the tuning fork motion of the column and overarm can be observed, *Fig.* 5. A relative motion in the slides between knee and column was also measured. Horizontal bending of the overarm, twisting of the column and relative motion between the column and knee were observed. The chatter frequency was 110 cps.

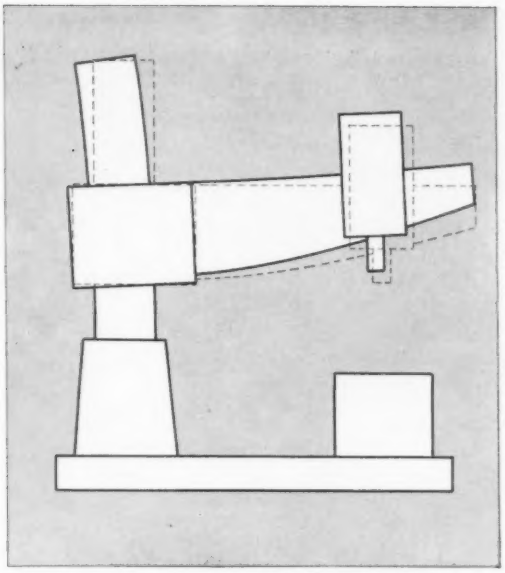


Fig. 6. Deformation of a radial drill during chatter and under vibratory testing conditions.

Qualitatively, similar deformation in a milling machine has been excited at a resonant frequency of 90 cps. In the same fashion as in the case of the investigated lathe chatter, the milling machine also exhibited a difference between the corresponding chatter and resonant frequencies.

Radial Drill: The chatter mode and the resonant mode of vibration in a radial drill are similar. The chatter amplitudes are approximately 20 times larger than the corresponding resonant amplitudes. The mode of vibration can again be referred to as a tuning fork mode (open mouth), *Fig.* 6. In the deformation of the machine structure, the bending of the column predominates. The frequency of chatter was 37 percent higher than the corresponding resonant frequency (15.6 and 12 cps, respectively).

Problems to Solve

Two problems appear to be of major importance relative to disturbing chatter vibrations: determining chatter origin, and preventing chatter.

At the present time, theory of chatter origin is still incomplete. The main difficulties lie in the application of the general knowledge to a particular case. This situation is due primarily to the complexity of the chatter problem caused by the variety of and variation in the parameters involved. These variables can be appreciated by considering the following points:

1. Different working conditions of the machine tool with respect to the cutting forces
2. Variations in structural features of machine tools
3. Variations in dynamic behavior of machine tools of different design
4. Influence of mounting of the workpiece and cutting tool.

There are so many factors which should be considered, the only practical approach to the problem lies in its simplification. This, however, presupposes that the importance of the particular parameters in a specific case is known well enough and that the decision of neglecting particular parameters is justified. This should be proved not just by mathematics, but by the applicability of the results obtained under simplifying assumptions.

Knowledge of the importance of different parameters, again, would be obtainable only through concurrent theoretical and experimental investigations, not only of chatter itself but also of associated problems such as dynamic rigidity of the machine-tool structure, dynamics of the cutting process, etc.

Prevention of Chatter

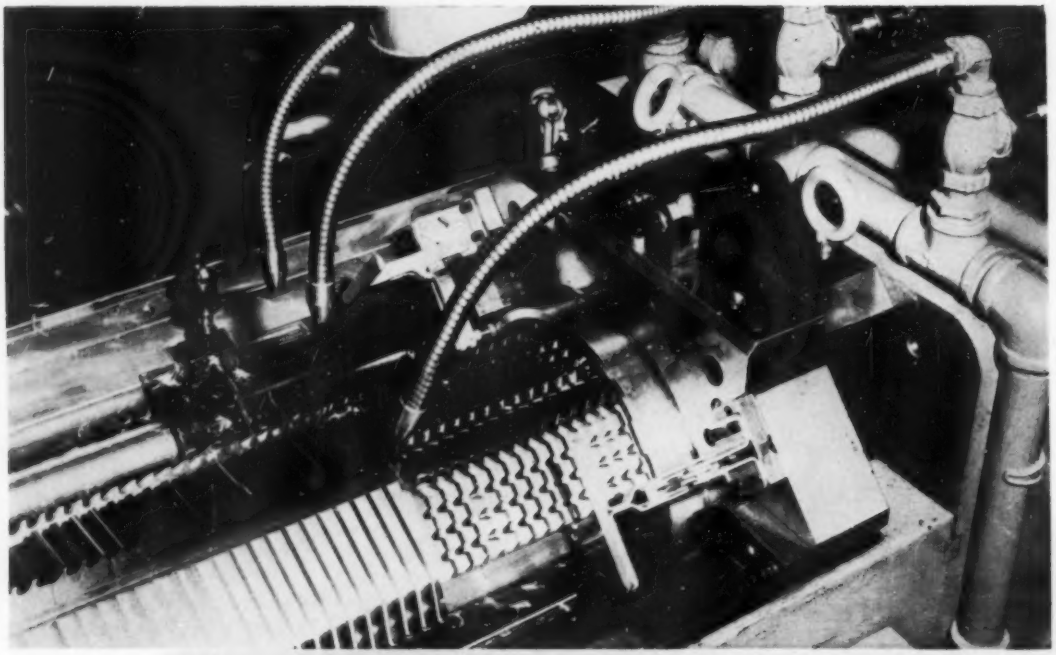
Problems, quite different from each other, involve either eliminating chatter in a given case of disturbance or creating a chatter-free machine tool. The first problem is usually an emergency case, in which the machine tool is in use or cannot pass performance tests. Here also, two main cases of instability are possible. One is more or less disadvantageous working conditions for the machine tool, which would operate satisfactorily under normal conditions. The other possibility is that the particular machine is exceptionally unstable if other machine tools of the same type perform satisfactorily.

In both cases, an immediate remedy is necessary. Frequently, the only remedy available is that of changing the cutting conditions or placing the job on a more rigid machine.

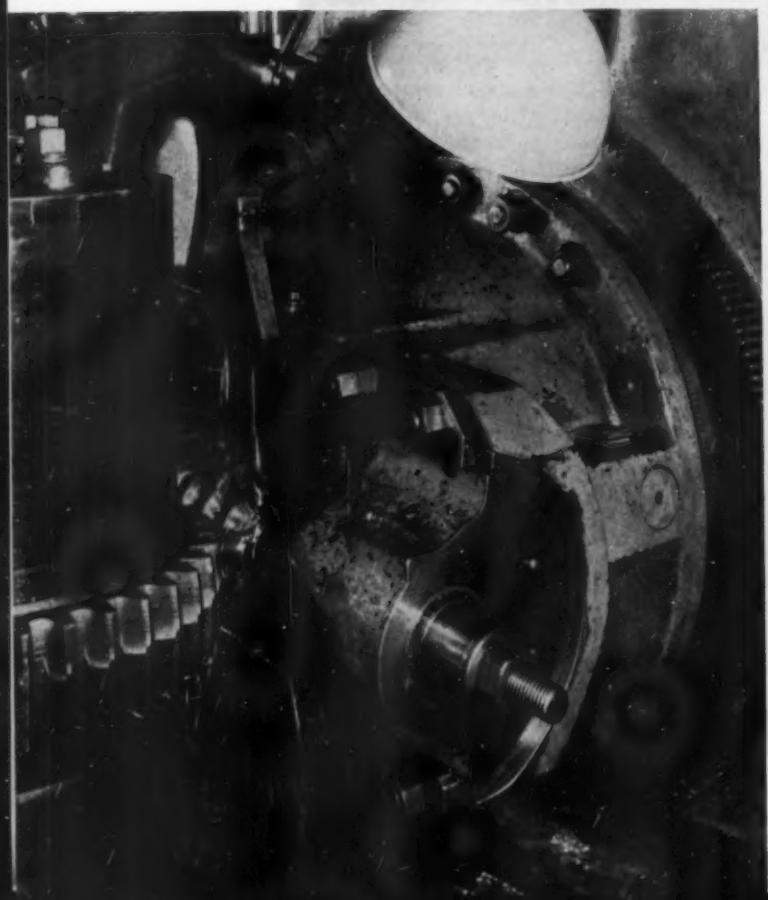
Building a chatter-free machine is of greater importance than preventing chatter vibrations in a given range of machine operations or increasing the range of operations. Procedure for eliminating chatter could include the following:

1. Measuring of the chatter modes of vibration
2. Exciting these modes under test conditions by using a vibration exciter
3. Changing the machine-tool stiffness for the particular mode of vibration, by using vibration absorbers or dampers, or by changing the machine-tool suspension in the case of a particular chatter disturbance and even by changing the design of the machine-tool structure.

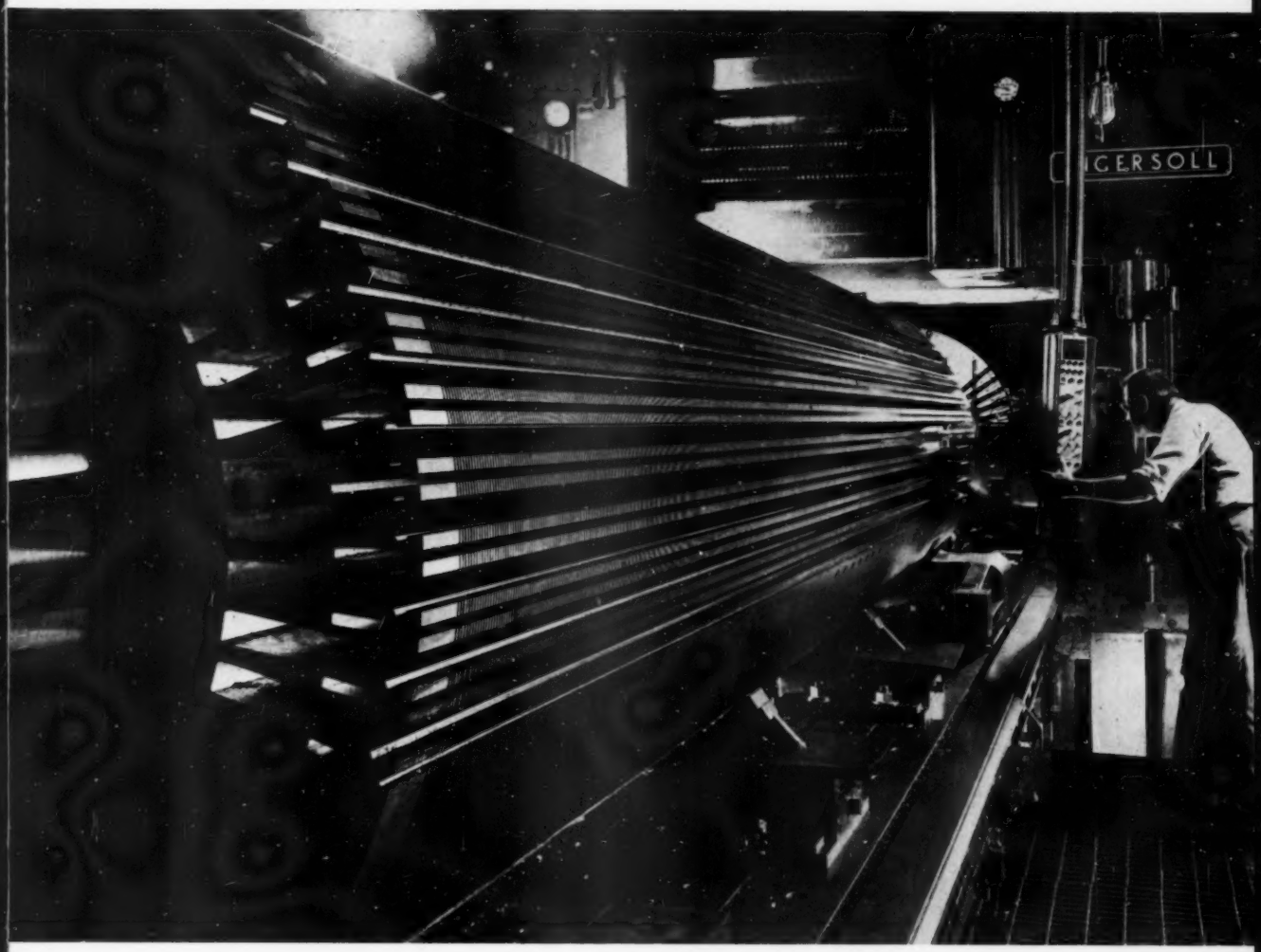
The advantage of such an approach can be seen in the fact that it joins the chatter problem to machine design. Chatter should, therefore, be considered at the first stage of design, with the primary intention being to prevent chatter rather than to cure it. Furthermore, this kind of approach underlines the importance of machine-tool design for good dynamic performance.



TEN SURFACES ARE FINISHED simultaneously on a Lapointe HP 30 broaching machine at Raytheon, Andover, Mass. Total cycle time including loading is 2.5 minutes. Formerly the same surfaces were machined in four operations on vertical millers requiring a total cycle time of 90 minutes.

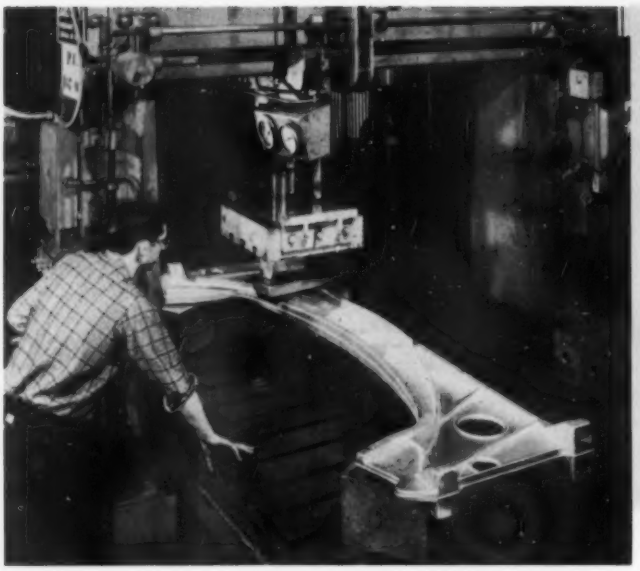


MULTIPURPOSE sulfurized-mineral cutting oil, Gulfcut 21 A, is used in crown hobbing coupling gears for rolling mills at E. W. Bliss Co., Salem, Ohio. Machining is done on a Gould & Eberhardt 72-inch hobber with a five-inch cutter operating at 50 rpm.



ROTOR for a 150,000-kw steam turbine-generator unit for the Enrico Fermi atomic power plant is slot-milled at Allis-Chalmers. The 1800-rpm unit will operate at 850 psig, 780 F and 1.0 inch Hg absolute exhaust pressure. The turbine will have one row of 46-inch exhaust blades.

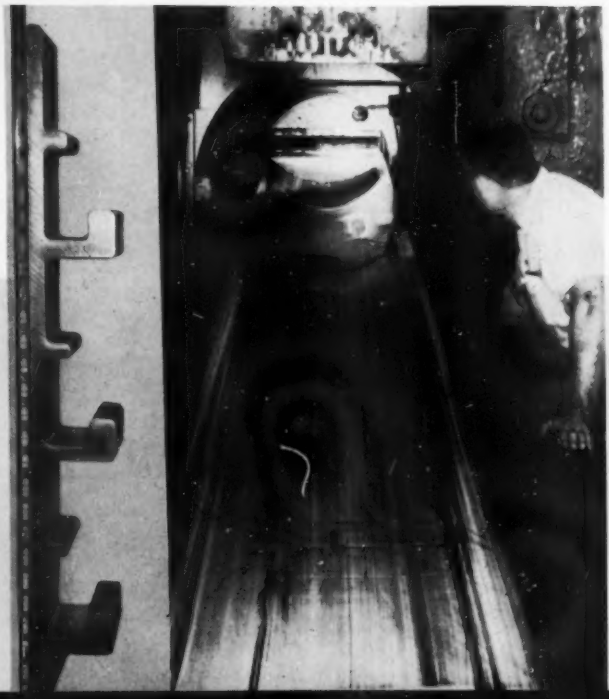
TOOLS at work



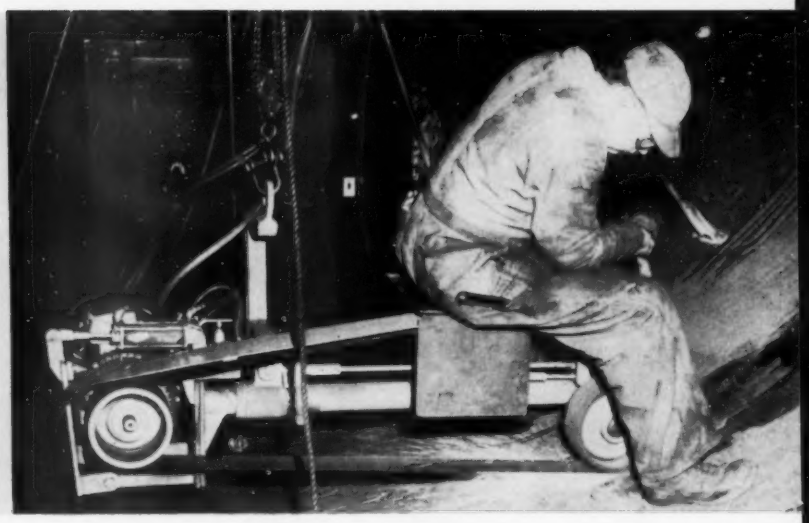
HIGH-STRENGTH, closed die forging is straightened at Alcoa's Cleveland Works. The 7075-T-6 alloy forging is 85 inches long and four inches thick at the heaviest section. This piece spans the fuselage at the wing roots. Wings are bolted directly to the forging at the juncture with fuselage skin.

INFRARED ANALYZER is used to detect fuel leaks inside jet seaplane wings at The Martin Co. A rubber cup with a hose attached to a nitrous oxide supply bottle is placed over the area where the leak was detected on the outside. Gas follows leak path to the inner source where it is detected by operator with a probe. Device is made by The Perkin-Elmer Corp.

TOOLS at work

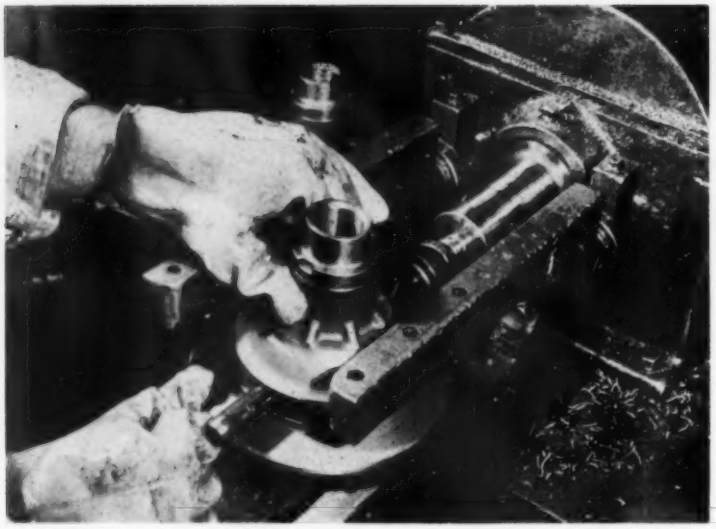


MEASURING 28.08 INCHES, 7178 aluminum alloy section is extruded flat at Harvey Aluminum, Torrance, Calif., on a 12,000-ton hydraulic press. The integrally stiffened panels are extruded on a production basis prior to final machining into structural wing components.



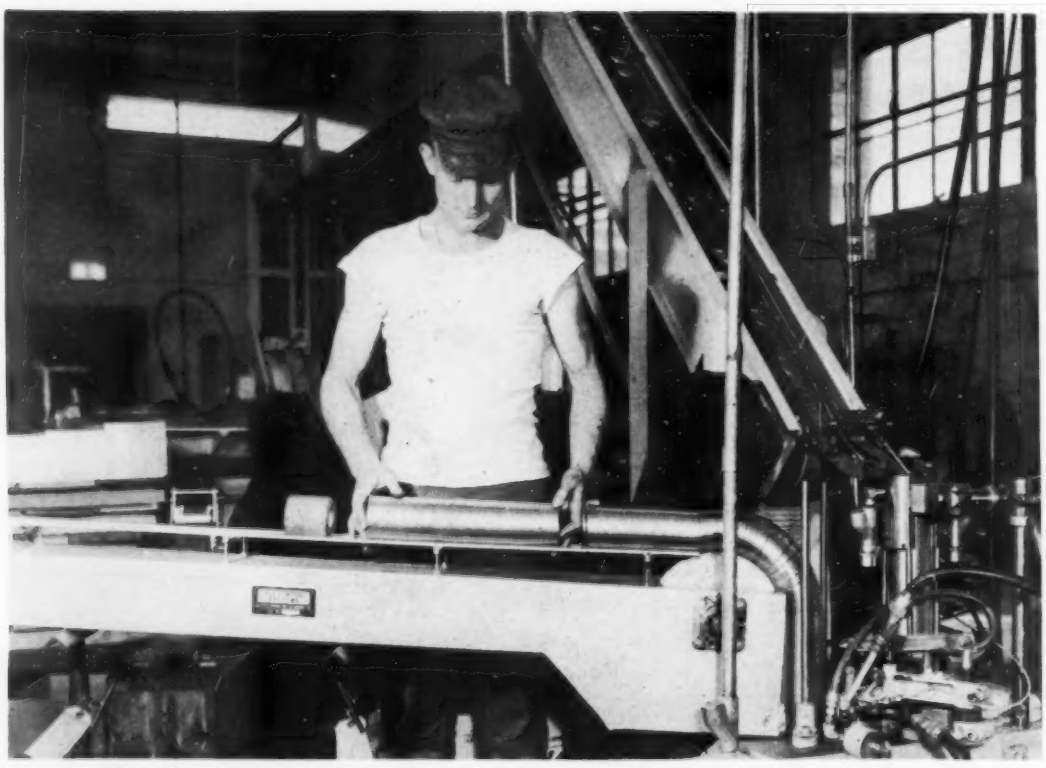
MOUNTED ON A SADDLE, an operator rides inside a large rotating tank to grind heavy welds. A standard belt grinder made by Grinding & Polishing Machinery Corp., Indianapolis, was adapted for this application. The grinder is powered by a 7½-hp motor and utilizes 4 x 132-inch abrasive belts.

TONGS FOR LIFTING COILS are adjustable for outside diameters from 25 to 40 inches. Gripping pressure is applied by engagement of a pawl in ratchet teeth and lever action of the hoist. Coil is released by lifting pawl of ratchet with the finger. Hoist is built by Heppenstall Co.



SINGLE TOOL completes three operations on differential cases at Ford Motor Co. As the tool enters the case, two holes on opposite sides of the case are reamed. When the shoulder of the tool is pressed against the edge of the case, a cam pin swings out a double-ended, carbide-tipped blade to chamfer the inside of both holes. The tool was designed by Cogsdill Tool Products, Inc., Oak Park, Mich.

TOOLS at work



CAN ENDS, emerging from a coating machine, are lifted around a corner by magnets in a wheel at the end of a stacking fixture, and guided onto rails. Use of the magnetic wheel lessons the dead load on the mechanism that pushes can ends from the coater. Horizontal stacker rods are also magnetic. The stacker, built by Fleetwood Systems, Inc., utilizes Eriez Magna-Roll and Magna-Rail units.

diamond-wheel GRINDING of tool steels

By L. P. Tarasov*
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High-vanadium, high-speed steels and die steels, difficult to grind conventionally, can be ground more rapidly and profitably with diamond wheels. These also generate far less heat than aluminum oxide wheels when high-carbon, high-chromium die steels are ground. Man-made diamonds are superior in these applications.

HIGH-VANADIUM STEELS, developed to provide greatly increased wear resistance, are generally difficult to grind. Wheel wear is extremely high so that it is sometimes impossible to grind these steels to the required tolerances. Grinding costs are also high.

This resistance to both wear and grinding results from the large amount of vanadium carbide present in these steels in the form of microscopic particles. All tool steels contain carbide particles of one or more varieties but vanadium carbide is much harder than the other carbides found in steel, its hardness being about the same as that of aluminum oxide. Thus, it is not surprising that an aluminum oxide wheel should wear extremely rapidly when grinding a high-vanadium tool steel. Silicon carbide is a somewhat harder abrasive and in some cases it has been found to perform a little better than aluminum oxide but not enough to make any significant difference. Any advantage it may show over aluminum oxide for grinding vanadium carbide is more or less balanced by its inferiority for grinding the martensitic matrix of the hardened steel.

*Senior member ASTE Worcester chaper.

Several approaches have been tried in an effort to overcome this grinding difficulty, but with only limited success. One method, developed initially to permit form grinding, involves the use of an aluminum oxide wheel at a low wheel speed, such as 3000 or 4000 fpm. In this speed range, the wheel wear is actually somewhat less for the high-vanadium tool steels than at the conventional wheel speed of about 6000 fpm. A much harder wheel can be used at the low wheel speed without the danger of heating the work surface excessively, and this further decreases the wheel wear. This method has been tried in enough instances to establish its validity, but the reduction in wheel wear is not very great and the method has not been widely used because of the practical difficulties associated with obtaining low wheel speeds in most shops.

Another way of reducing wheel wear is to do as much grinding as possible before the steel has been hardened, with just enough stock left for finish grinding to take care of the distortion resulting from heat treatment. The improvement in grinding is due entirely to the characteristics of the annealed work material, but this solution is obviously applicable only in special cases and does not take care of any finish grinding difficulties.

It has also been found that sulfurization of high-vanadium tool steels to make them free-machining causes a considerable reduction in wheel wear when they are ground in the hardened condition. Even so, the wheel wear remains fairly high, about the same as for a plain high-carbon, high-chromium die steel. For applications in which the sulfurized versions are both available and suitable, these steels furnish a way of reducing grinding costs.

Vanadium carbide is in the same general hardness range as the carbides present in cemented carbide tools. This suggested the possibility of using

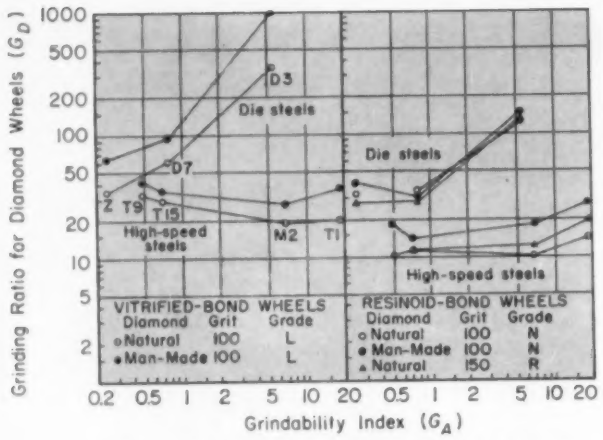

Fig. 1. Grinding ratios for diamond wheels as a function of grindability index G_A, based on a 32A60-H8VG wheel used under specific grinding conditions.

diamond wheels for grinding the high-vanadium tool steels. It is true that ordinary steels cannot be ground successfully with diamond wheels since they wear much too rapidly as a result of the diamonds being plucked out by the steel. However, this would not necessarily hold for the high-vanadium tool steels whose resistance to grinding is much more like that of the cemented carbides.

If diamond wheels are to be given serious consideration for grinding these steels, they must not only produce a satisfactory quality of the work surface, but they must also be more economical to use than conventional wheels. Preliminary evaluation of a number of vitrified bond diamond wheels in tests on several high-vanadium steels showed that some wheels performed reasonably well as judged by the sound of the operation and the appearance of the work surface. In fact, the best wheels sounded about the same as a soft aluminum oxide wheel used on any ordinary tool steel. Once it was established that a satisfactory grinding action could be obtained with diamond wheels, the economic aspects of the problem became of prime interest.

Determination of Grinding Costs

The cost of grinding a given part can be considered to consist of the cost of removing a certain amount of stock and the cost of obtaining the required tolerances. The cost of removing a unit volume of material, or the volumetric cost, can be readily evaluated by means of a laboratory test in which the grinding conditions are about the same as would be used in actual practice. Changes in the size of the wheel and workpiece have a relatively small effect on this cost, but they can have a large effect on the cost of meeting the tolerance requirements if the material is difficult to grind and results in high wheel wear. Thus the tolerance cost cannot be obtained adequately from a laboratory test in which the dimensions of the wheel and work are kept within a reasonably narrow range but must be determined for each case under shop conditions.

For this reason, the economic advantage or disadvantage of grinding with a diamond wheel will be based solely on the volumetric cost. If a particular low-grindability steel (one that is difficult to grind) can be ground more cheaply with a diamond wheel than with an aluminum oxide wheel on a volumetric cost basis, this will hold true regardless of the relative size of the wheel and workpiece. Increasing the size of the work relative to that of the wheel will simply increase the tolerance cost for the rapidly wearing aluminum-oxide wheel and hence will make the diamond wheel stand out even more favorably. However, if the volumetric cost is found to be somewhat greater for the diamond wheel than for the aluminum oxide one, the former may still turn out to be more economical to use when the actual workpiece is sufficiently large with respect to the wheel. Under such circumstances, the added tolerance cost for the aluminum oxide wheel may be greater than the savings realized from the lower volumetric cost, and diamond wheel grinding will be economically advantageous.

The volumetric cost itself consists of the wheel cost, which results from wheel wear during grinding, and the time cost, which takes care of labor and overhead. If the various costs related to dressing the wheel are relatively high, they should also be included, but in this work they were small enough to be safely neglected. Other costs, such as those connected with setup, handling time, and grinding fluid, should not be appreciably affected by the type of wheel used and they were also ignored. All these miscellaneous costs depend on the particular circumstances that give rise to them, and they should be evaluated under shop conditions if they are to have any real meaning. If they form a

Composition of Tool Steels Tested

AISI Type	Nominal Analysis (percent) C	W	Mo	Cr	V	Co	Hardness (R_c)
T1	0.7	18	—	4	1	—	64
M2	0.8	6	5	4	2	—	64
T15	1.6	13	—	5	5	5	67
T9	1.3	18	1	4	4	—	64
D3	2.1	—	—	12	—	—	64
D7	2.4	—	1	13	4	—	65
Z*	3.3	—	1	1	12	—	61

*Arbitrary designation in absence of any AISI designation.

substantial part of the total production cost, the relative economic advantage of one wheel over another will differ somewhat from the advantage based on the volumetric cost alone.

This cost can be readily calculated for all precision-grinding operations (provided the width of contact between wheel and work does not change) with a simple equation whose derivation is given in the latter part of the article.

$$C = \frac{C_t}{S} + \frac{\frac{HC_t}{S} + C_w}{G} \quad \ldots\ldots(1)$$

where C is the volumetric grinding cost in dollars per cu. in. of material removed, C_t the unit time cost in dollars per hour, C_w the unit wheel cost in dollars per cu. in. of usable portion or wheel, S the rate of feed in cu in. per hour, H the ratio of the work surface area to that of the wheel, and G the grinding ratio, which is the volume of material removed per unit volume of wheel wear. If S and H are kept the same throughout a test involving various wheels and steels, and assuming a constant value of C_t, Equation 1 reduces to an even simpler form,

$$C = a + \frac{b}{g} \quad \ldots\ldots(2)$$

where b is a function of the wheel cost C_w.

Experimental Conditions

In the course of this investigation, 22 diamond wheel specifications and 23 tool steels were looked into, in most cases very briefly. The largest portion of the work was devoted to a thorough study of five satisfactory diamond wheels and seven representative tool steels that are considered at least moderately difficult to grind. Data for a suitable aluminum oxide wheel were also obtained for comparison.

Equipment used in the tests was a 6 x 18-in. horizontal-spindle, reciprocating-table surface grinder. The test block was 6 in. long and 1½ in. wide, and was ground lengthwise. A 1:80 emulsion of soluble oil in water was used as a grinding fluid.

For testing diamond wheels, wheel size was 7-in. diameter, ½ in. wide. Wheel speed was 6000 fpm and table speed was 750 ipm. Unit crossfeed was 0.050 in. after each traverse; unit downfeed was 0.001 in. after each completed crossfeed. Total downfeed for preliminary grinding (to break in the wheel face) was 0.010 in. Total downfeed during test grinding was 0.020-0.300 in., generally 0.050 in.

Standard grinding conditions for aluminum oxide wheels were the same as for diamond wheels, except that the wheels were 7 to 8-in. diameter and different total downfeeds were used. These were 0.004 in. for preliminary grinding and 0.010 in. for tests.

Effects of wheel speed, unit downfeed, type of grinding fluid and the method of applying fluid were also studied briefly. The diamond wheels were trued as required with a brake-controlled silicon carbide wheel, and were dressed with a silicon carbide stick prior to each run. The aluminum oxide wheel was diamond dressed prior to each run.

Wheel wear and material removed were determined by micrometer measurements. Net power consumption, which is an approximate measure of the heat generated in the work surface was obtained

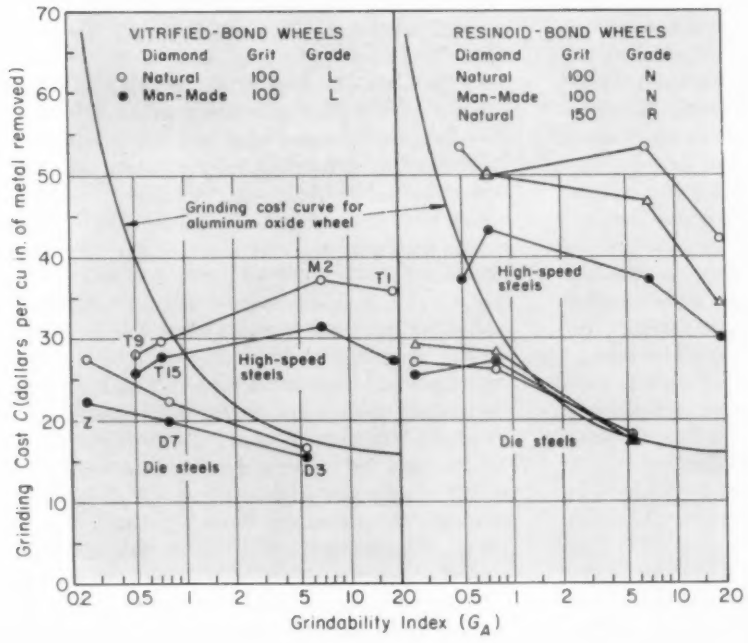

Fig. 2. Comparison of grinding costs for diamond and aluminum oxide.

by means of a recording wattmeter. Surface roughness was measured on a profilometer.

The grinding ratio, which is a measure of the grindability, or the ease of grinding a material with a given wheel under specified conditions, was readily calculated from the wheel wear and material removal data. In order to compensate for gradual variations in the grinding ratio with wheel diameter in the tests involving the aluminum oxide wheel, this was calibrated periodically against a standard test block. The test data were corrected accordingly.

Grinding ratios and costs were obtained for the four high-speed steels and three die steels described in the accompanying table. T1 and M2 are conventional high-speed steels, while T15 and T9 are high-vanadium varieties. D3 is an ordinary high-carbon, high-chromium die steel; D7 is a high-vanadium modification of it, and Z is a 12 percent vanadium die steel. These steels were ground with both natural and man-made 100-grit diamond wheels, grade L in vitrified bond and grade N in resinoid bond, and with a 150-grit natural diamond wheel, grade R in resinoid bond. They were all 100-concentration wheels (72 carats per cu in. of diamond layer).

Other steels that were tested at one time or another, mostly in single runs, included high-speed steels, highly alloyed die steels, a few free-machining varieties and a finishing steel. The additional diamond-wheel variables that were investigated briefly were grit size (46 to 220), wheel grade (H to R), diamond concentration (50 to 200), and type of vitrified or resinoid bond. Except for the five wheels mentioned above, most of the diamond wheels were not satisfactory because they either generated too much heat or wore too rapidly.

A soft, vitrified-bond, semifriable aluminum oxide wheel, 32A60-H8VG, was also evaluated to provide comparable data for conventional grinding. The grinding ratio obtained with this wheel for each steel was used as its grindability index. This quantity describes the relative ease of removing material under the actual test conditions, a steel having a high grindability index being easier to grind than one with a low index. Characterizing each steel by a grindability index based on conventional grinding practice made it possible to present the diamond-wheel data in terms of curves instead of the complicated bar charts or tabulations that would otherwise have been necessary. Had a different aluminum oxide wheel been used, the grindability index for each steel would also have been different, but the general relationship would have been the same, provided the wheel was a suitable one.

Grinding Ratios

The diamond-wheel grinding ratios are plotted in *Fig.* 1, logarithmic coordinates being used to conveniently accommodate both high and low numerical values. It is immediately apparent that the die steels lie on entirely different curves than do the high-speed steels. When the die steels are ground with the vitrified-bond diamond wheels, the grinding ratio G_D rises rapidly with increasing grindability index G_A, but there is relatively little effect of G_A on G_D for the high-speed steels. Actually, there is first a gradual drop in G_D as G_A increases, and then a rise. The curves for the resinoid-bond diamond wheels are of a similar nature although they differ in some details and are lower than the corresponding curves for the vitrified-bond diamond wheels.

In making comparisons between various wheels, it is necessary to keep in mind that they may differ in grinding grade even if the grade letter is the same. Thus a higher grinding ratio may be associated with a more suitable wheel or with a harder wheel. To determine which, it is necessary to consider wheel grinding quality, which will be discussed after the subject of grinding costs has been covered.

Grinding ratios are considerably higher for man-made diamond than for natural except when the die steels are ground with the resinoid-bond wheels. In this case, the two types of diamond do not differ significantly.

The effect of grit size in the resinoid-bond wheels may be influenced by the difference in wheel grade. The grinding ratio is higher for the 100-grit wheel in some instances and lower in others, but the difference is generally very small.

Grinding-Cost Data

The volumetric grinding costs calculated from these grinding ratios are plotted in *Fig.* 2. The smooth curve is for the aluminum oxide wheel and is derived directly from Equation 2 for any value of G, which is the same as G_A for this wheel. The diamond-wheel grinding cost can be calculated only for the grinding ratios that have been experimentally determined for these wheels since these quantities, denoted by G_D, are entirely different from the grindability index G_A. Any point below the smooth curve represents a diamond-wheel and steel combination for which the volumetric cost is less than for the aluminum oxide wheel and the same steel; above the curve, the diamond-wheel cost is greater.

It is seen that all three die steels and the two high-vanadium high-speed steels T9 and T15 can be ground more economically with either of the vitrified-bond diamond wheels than with the aluminum oxide wheel, but this does not hold for the M2 and T1 high-speed steels. It is worth noting that, although the grindability index G_A, based on conventional grinding practice, may be practically the same for two steels like D3 and M2, yet the diamond-wheel grinding costs may differ greatly because the diamond-wheel ratios are so different. For

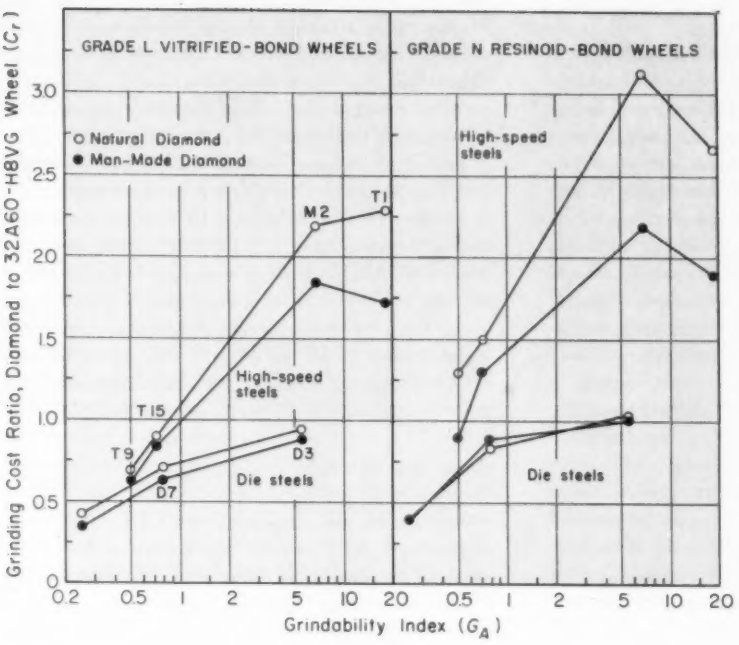

Fig. 3. Grinding-cost ratios for 100-grit diamond wheels. Below the horizontal line corresponding to $C_r = 1.0$, the grinding cost per cu in. of material removed is less for the diamond wheels than for a 32A60-H8VG aluminum oxide wheel.

all the steels, the wheel containing man-made diamond is more economical to use than the one with natural diamond.

The cost curves for the resinoid-bond diamond wheels are similar although appreciably higher for most of the steels. As a result, the volumetric grinding cost for all the high-speed steels is less when conventional practice is followed, the only exception being the combination of T9 steel and the man-made diamond wheel. For the D3 steel, the volumetric cost is the same for the diamond wheels as for the aluminum oxide wheel. Thus replacement of vitrified bond with resinoid reduces the number of steels that can be ground more economically with diamond wheels. As would be expected from the corresponding grinding-ratio curves for the resinoid wheels, the man-made diamond wheel is more economical for grinding the high-speed steels than are the natural diamond wheels, but there is no significant difference in grinding cost between these wheels when the die steels are ground.

Comparable volumetric cost figures were obtained for a general-purpose cemented tungsten carbide considered to be quite resistant to grinding. The cost of grinding this cemented carbide with a vitrified-bond man-made diamond wheel at the same feeds and speeds as were used for the steels is calculated to be $19 per cu in. of carbide removed, while for a similar wheel containing natural diamond, the cost is $22 per cu in. The corresponding figures for resinoid wheels are $24 and $26 per cu in. In view of the difference between the conditions under which the steels and the cemented carbide were actually ground, all that can be said is that the diamond-wheel grinding cost is approximately the same for the cemented carbide as for the D7 steel and that the other high-vanadium steels are somewhat more expensive to grind.

Since the grinding-cost curve for the aluminum oxide wheel in *Fig.* 2 varies so rapidly with the grindability index of the steel, it is advantageous to replot the results on a relative cost basis, as is done in *Fig.* 3. Here the ordinate is the grinding-cost ratio, or the volumetric grinding cost for the diamond wheel divided by the corresponding cost for the aluminum oxide wheel. Below the line $C_r = 1.0$, the diamond wheel is more economical to use, while above it the opposite is true, at least on a volumetric basis. The curves for the 150-grit resinoid wheel are omitted for the sake of clarity but their approximate locations can be readily estimated from *Fig.* 2. With this method of plotting, it is easy to see that the cost ratio changes in the same general manner with the grindability index for both the high-speed and the die steels.

Although it is somewhat more expensive to grind these steels with a resinoid-bond than with a vitrified-bond diamond wheel, the former is likely to be available in the right wheel size wherever carbides are ground while a vitrified wheel would have to be ordered. Thus the possibility of changing over to diamond wheels for grinding the low-grindability tool steels can be readily investigated in the toolroom without the necessity of obtaining a special wheel. Grit sizes between 100 and 150 can be used equally well for this purpose.

Effect of Grinding Time

A few runs with the vitrified-bond natural diamond wheel showed that when the unit downfeed was increased from 0.001 to 0.002 in., the grinding ratio remained about the same, increasing somewhat for one of the high-vanadium steels and decreasing for two others. The volumetric grinding cost decreased for both the aluminum oxide wheel and the diamond wheel when T15 was ground, but the decrease was enough greater for the aluminum oxide wheel that this one became more economical to use at the higher downfeed even though the reverse was true at the lower downfeed. The primary reason for this was that the time cost required to compensate for wheel wear dropped substantially for the aluminum oxide wheel when the downfeed was doubled, but it was not appreciably affected for the diamond wheel since it was very small to begin with. Thus the volumetric cost per cu in. of material removed dropped from $33 to $19 for the aluminum oxide wheel: from $30 to $26 for diamond.

Any change in grinding conditions that reduces the grinding time will favor the aluminum oxide wheel relative to the diamond one from the standpoint of grinding cost. However, when the grinding-cost ratio C_r is sufficiently low, as for steels Z, T9 and D7 ground with a vitrified-bond diamond wheel, even substantial savings in grinding time are unlikely to overcome the economic advantage of the diamond wheel. In general, the grinding conditions used throughout most of this study result in as high a volumetric rate of feed as is likely to be used in toolroom grinding of the high-vanadium steels so that the cost data in *Figs.* 2 and 3 can be considered to represent grinding rates that would normally not be exceeded by any substantial amount if the wheel is of similar size.

Sulfurized or free-machining versions of the high-vanadium tool steels can be ground satisfactorily with diamond wheels, at least from the standpoint of grinding action. The grinding ratios are roughly the same as for the regular counterparts and the diamond-wheel grinding cost does not change appreciably. When an aluminum oxide wheel is used, however, the grinding ratio is considerably higher for the sulfurized steel and the grinding cost is lower. Thus changing from the regular to the free-machining variety of a high-vanadium steel may make an aluminum oxide wheel more economical to use than a diamond wheel, where the reverse is true for the unsulfurized steel.

A considerable number of other steels were investigated very briefly. These tests showed that for high-speed steels containing less than 3 percent vanadium the volumetric grinding cost would generally be less if an aluminum oxide wheel was used. The same was found to hold for F2 steel, which is a water-hardening carbon-tungsten steel sometimes referred to as a finishing steel. Although this steel can be very difficult to grind conventionally, a diamond wheel cannot be justified on a strictly volumetric cost basis, but it may be the more economical wheel if the cost of obtaining the required tolerances is sufficiently high.

Two high-carbon, high-chromium die steels, D2 and D4, which have analyses similar to that of D3, were also ground at somewhat lower cost with a diamond wheel, and it is likely that this would be true of all AISI type D steels. Another wear-resistant steel, A7, which contains approximately 5 percent each of chromium and vanadium, was found to be similar to D7 in its grinding characteristics. Field experience with A7 has fully confirmed the economic advantage of diamond wheels.

Grinding Quality

Net power consumption, taken in conjunction with the grinding ratio, provides a useful indication of wheel performance. If two wheels are used under the same conditions and result in the same grinding ratio, the one for which the power is lower is superior because it generates less heat for the same amount of wheel wear. Likewise, if the power is the same for two wheels, the one for which the grinding ratio is higher is superior.

In evaluating the relative grinding quality of various types of wheels for a given steel, the usual procedure is to run tests with several grades of each type and to plot the net power P against the grinding ratio G. In the normal grinding range, it is found that P is roughly proportional to G for each type of wheel. The highest quality is associated with the lowest curve since this corresponds to the least heat generation for a given value of G. Thus the inverse slope of the curve, given by G/P, can be used to characterize the grinding quality of that type of wheel. This is the quality index Q.

Since it was not feasible in most instances to use more than a single grade of each type of diamond wheel, quality curves could not be plotted but Q could still be calculated for each wheel. Because the proportionality between P and G is only approximate, small differences in Q cannot be considered significant, but appreciable differences, especially when obtained consistently for a variety of steels, are reliable indicators of relative wheel quality.

The quality index for the diamond wheels is plotted in *Fig.* 4 against the grindability index based on the aluminum oxide wheel. Q is given in terms of reciprocal kilowatts, which is the same as expressing $1/Q$ in kilowatt units. The curves are similar to the corresponding ones for the grinding ratio, plotted in *Fig.* 1. The grinding quality of man-made diamond is seen to be superior to that of natural diamond in every instance, even when the die steels were ground with the resinoid-bond wheels, a con-

dition under which the two types of diamond did not differ significantly with respect to grinding ratio.

In all likelihood, the superiority of man-made diamond for grinding these steels can be attributed to its greater friability, which makes for sharper grains and results in a cooler grinding action. In the majority of cases, the man-made diamond also dulled less rapidly as shown by the lower rate at which the power consumption increased as grinding continued. The quality curves also show the clear-cut superiority of vitrified over resinoid bond for the conditions of this investigation.

It is not known why the die steels and the high-speed steels fall on entirely different quality curves when diamond wheels are used. Perhaps the nature of the wear-resistant carbide particles in the steel is responsible for this.

When the steels were ground with the aluminum oxide wheel, the quality indexes, just like the grinding ratios, were in most cases far lower than for the diamond wheels. The values of Q were 0.92 for steel Z, 2.7 for T9, 4.2 for D7 and T15, 15 for D3 and M2, and 65 for T1. Comparison of these quantities with the corresponding ones in *Fig.* 4 shows that Q is lower for the aluminum oxide wheel than for the diamond wheels, the only exception being T1 ground with natural diamond. With the exception of M2 and T1, diamond is not only an economically advantageous abrasive for grinding these steels, but it is likewise greatly superior to aluminum oxide from the standpoint of grinding quality.

Power Consumption and Grinding Heat

For most of the low-grindability tool steels, the net power consumption was appreciably higher for the diamond wheels than for the aluminum oxide wheel. However, the latter wore so rapidly that low power consumption was to be expected. When this wheel was used at sufficiently great unit downfeeds to make the depth of cut equal to 0.001 in., corresponding to the depth of cut attained with the diamond wheels, then the power consumption and grinding heat were generally closely comparable for the two abrasives. In view of the far higher grinding ratios obtained with the diamond wheels, this is another indication of their inherent superiority for grinding these steels.

The plain high-carbon, high-chromium die steels (D2, D3 and D4) differed from all the other steels in that, for the same unit downfeed of 0.001 in., the net power consumed was half as much or even less for the diamond wheels as for the aluminum oxide wheel.

Net power consumption for aluminum oxide was 8.3 for D2 steel, 8.9 for D3 steel and 6.5 for D4 steel. For diamond, the figures for the same steels were 4.4, 2.7 and 3.3. Power is expressed in arbitrary units for the aluminum oxide and the 100-grit vitrified-bond diamond wheels. Different wheels were used for D2 than for the other two steels. It is apparent that for these steels, much less heat is generated with a diamond wheel even though it is removing stock at a somewhat higher rate.

Surface Finish

At the end of the test runs in which the grinding ratios were obtained for the various steels, the surface roughness fell in the range of 15 to 27 microinches rms, with a few exceptions. The surface was generally slightly rougher when ground with man-made diamond than with natural diamond. The D3 steel came out considerably rougher, about 35 mi-

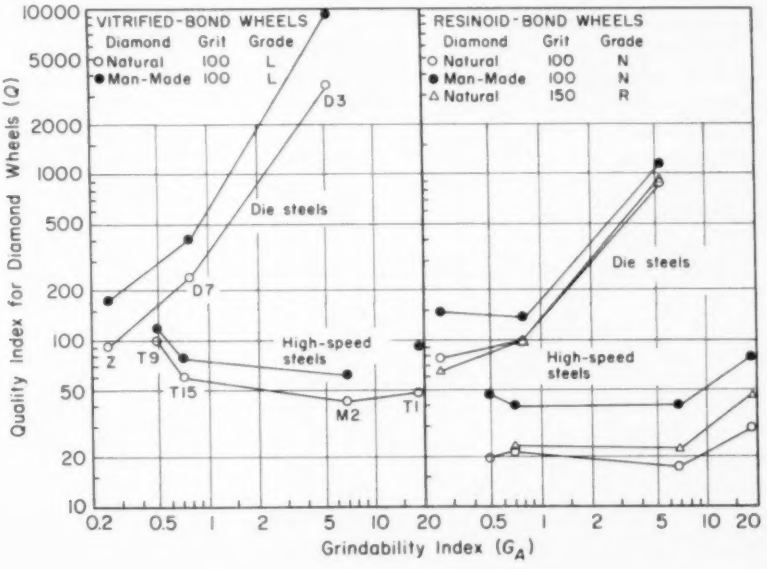

Fig. 4. Quality index for diamond wheels.

croinches rms, with both types of diamond and the other plain high-carbon, high-chromium die steels are likely to behave similarly.

Finish-grinding conditions, in which the unit crossfeed and downfeed were reduced, resulted in very good finishes when the 150-grit, resinoid-bond natural diamond wheel was used. When the unit crossfeed and downfeed were 0.010 and 0.0001 in. respectively, the surface roughness of the high-vanadium steels was only 4 or 5 microinches rms, but again it was higher for D3, amounting to 8 microinches. Speeding up the finish-grinding operation by increasing the crossfeed to 0.025 in. and the downfeed to 0.00025 in., resulted in an increase of only about 2 microinches for all these steels. Two of the steels, T9 and Z, were also finish ground with a 220-grit vitrified-bond natural diamond wheel in an attempt to obtain an even better finish, but the results were the same as for the 150-grit wheel when T9 was ground, and slightly poorer for Z.

Operating Variables

Several grinding variables were investigated briefly for the 100-grit vitrified-bond natural diamond wheel used under stock-removal conditions. As pointed out previously, increasing the unit downfeed from 0.001 to 0.002 in. had no significant effect on the grinding ratio of three of the high-vanadium steels; however, the surface roughness went up considerably. Reduction in wheel speed from 6000 to 2000 fpm when grinding T15 caused the grinding ratio to drop relatively little, from 29 to 20, and the net power consumption went down correspondingly, but the surface became much rougher, as would be expected. It is possible that man-made diamond, because of its greater friability, would be affected more than natural diamond by such changes in unit downfeed or in wheel speed, but this point was not investigated.

The grinding ratio of this steel was not affected when the general-purpose soluble oil used throughout most of the work was replaced by a much higher concentration of a heavy-duty product, but there was an appreciable drop in the power consumption. Thus the nature of the grinding fluid can affect the performance of diamond wheels used for grinding the low-grindability steels.

Application of the grinding fluid in the form of a fine mist instead of through a conventional nozzle made it necessary to reduce the volumetric feed rate in order to be able to grind D7 steel without severe damage to its surface. A vitrified-bond man-made diamond wheel was used in this study. Decreasing the unit downfeed from 0.001 to 0.0005 in. or the table speed from 750 to 450 ipm made it possible to use mist, but in the latter case it was also necessary to replace the soluble-oil emulsion with plain water containing a little rust inhibitor of the nitrite type. Evidently the soluble-oil emulsion interfered with the proper functioning of the mist. Dry grinding was also tried, but it failed even under conditions that were satisfactory for mist-grinding.

Although the evaluation of diamond wheels was limited to surface grinding with the periphery of the wheel, it is highly probable that the wheels found to be satisfactory for this operation can also be used for other operations, such as cylindrical and internal grinding. Only experiences will show whether the wheel grade will require any modification. In one instance, the same 100-grit vitrified-bond man-made diamond wheel specification that gave the best results in the surface-grinding tests was found by a tool and die shop to perform satisfactorily for the internal grinding of A7 steel. In another case, a 150-grit grade N resinoid-bonded natural diamond wheel has been used successfully for several years in the cylindrical grinding of steel Z.

Conclusions

On the basis of extensive laboratory surface-grinding tests, supplemented by some field experience, high-vanadium high-speed steels and die steels can be ground more economically with vitrified-bond diamond wheels than with aluminum oxide wheels. Diamond wheels found suitable for this purpose are 100 grit in grade L and 100 concentration.

Resinoid-bond wheels, which are likely to be on hand in the toolroom for grinding carbides, are

Nomenclature

A_m = surface area ground
A_w = area of wheel face subject to wear
C = volumetric grinding cost per unit volume of material removed
C_t = time cost (labor and overhead) per unit time
C_w = wheel cost per unit volume of usable portion of grinding wheel
F = unit feed perpendicular to work surface (radial for round parts)
G = grinding ratio V_m/V_w
H = ratio of surface areas, A_m/A_w
M = thickness of material removed (radial for round parts) per unit feed
S = volumetric feed per unit time
t_g = time to remove single layer of area A_m
V_m = volume of material removed per unit feed
V_w = volume of wheel wear per unit feed
W = radial wheel wear per unit feed

Note: Any consistent set of units can be associated with these symbols. A convenient one to use is based on inches, hours and dollars.

somewhat more expensive to use on these steels than those made with vitrified bond. They are more economical than aluminum oxide wheels for grinding the high-vanadium die steels but not the high-speed steels. Resinoid-bond wheels found to be satisfactory are 100 grit in grade L and 150 grit in grade R, both in 100 concentration.

The economics of the operation is based solely on the cost per cu in. of material removed. Cost of meeting the required tolerances, which obviously depends on a great many other factors and thus cannot be obtained in a standardized laboratory test, is ignored in these comparisons. In actual practice, however, even though a steel can be ground somewhat more economically with an aluminum oxide wheel on a strictly volumetric basis, the cost of meeting the required tolerances with this wheel may be so high that the total grinding cost will be less for a diamond wheel. This point should not be overlooked when the volumetric cost superiority of the aluminum oxide wheel is not substantial.

Ordinary high-carbon, high-chromium die steels can also be ground to advantage with diamond wheels. Although there is little or no advantage on a volumetric cost basis, far less heat is generated with diamond than with aluminum oxide.

For all the tool steels that were investigated in this respect, man-made diamond was found to be somewhat superior to natural diamond from the standpoint of both grinding cost and grinding action.

Increasing the unit downfeed from 0.001 to 0.002 in. did not affect the grinding ratio significantly when a vitrified-bond natural diamond wheel was used. Decreasing the wheel speed from 6000 to 2000 fpm resulted in only a relatively small reduction in the grinding ratio.

The high-vanadium tool steels should normally be ground wet with diamond wheels. It is best to have the work surface flooded with the grinding fluid, an ordinary soluble-oil emulsion being suitable for the purpose. If necessary, the fluid can be applied in the form of a mist, but the rate of cut may have to be reduced and plain water containing a little rust inhibitor may be substituted for oil.

Derivation of Cost Equation

In the absence of wheel wear, the time cost of removing a unit volume of material is C_t/S, where $S = FA_m\ t_o$. Wheel wear increases the grinding time by a factor of F/M, so that the actual time cost becomes C_tF/SM.

Since G volumes of material are removed per unit volume of wheel wear, corresponding to a wheel cost C_w, the wheel cost for removing a unit volume of material is C_w/G. The total cost is thus:

$$C = \frac{C_tF}{SM} + \frac{C_w}{G} \qquad \text{(A1)}$$

The grinding ratio G being a function of both F and M, it is possible to reduce by one the number of variables in Equation A1. Since $F = M + W$:

$$C = \frac{C_t\ (M + W)}{SM} + \frac{C_w}{G}$$

and since $W = V_w/A_w$, and $M = V_m/A_m$,

$$\frac{W}{M} = \frac{\frac{A_m}{A_w}}{\frac{V_m}{V_w}} = \frac{H}{G}$$

Hence the value of C is:

$$C = \frac{C_t}{S} + \frac{HC_t}{SG} + \frac{C_w}{G}$$

$$= \frac{C_t}{S} + \frac{\frac{HC_t}{S + C_w}}{G} \qquad \text{(A2)}$$

An advantage of this form of the cost equation is that for a given set of grinding conditions, all factors except G remain the same when the work material is changed. In Equation A1, under the same circumstances, C depends on two variables, M and G.

The first term in Equation A2 is the time cost in the absence of wheel wear; the second term, HC_t/SG, is the additional time cost attributable to the extra feeds necessary to compensate for wheel wear; and the final term, C_w/G, is the wheel cost. These costs are all for unit volume of material removed.

For the grinding conditions described, the measured value of t_o, which included the additional time required at the end of each stroke and of each complete traverse, was 0.0137 hr. Together with the tabulated values for F and A_m, this led to $S = 0.658$ cu in./hr. The calculation for H was based on a nominal wheel, 7 in. in diameter and ½ in. wide. This resulted in $H = 0.819$. If it is assumed that C_t = \$10/hr., Equation A2 then becomes

$$C_t = 15.2 + \frac{b}{G} \qquad \text{(A3)}$$

where $b = 12.45 + C_w$

The wheel cost C_w is equal to the net cost of the wheel divided by its usable volume. This was 2.65 cu in. for a diamond wheel with ¼-in. rim thickness, and 11.0 cu in. for an aluminum oxide wheel used from the original 8-in. diameter down to the 6-in. discard diameter.

For the diamond wheels, C_w ranged from \$367 to \$425 per cu in., depending on the types of bond and diamond that were used. The corresponding figure for the aluminum oxide wheel was only \$0.31. Thus for a diamond wheel, b in Equation A3 consists almost entirely of the wheel cost while for an aluminum oxide wheel the wheel cost portion of b is extremely small.

Fig. 1. Plastics vacuum chuck is fabricated with gel coat and laminated. Eggcrating is then added for reinforcement and filled with lightweight aggregate and resin.

PRACTICAL PLASTICS TOOLING IDEAS

Abstracted from Paper 227, "Practical Applications for Plastic Tools in the Aircraft and Missile Industry," to be presented at the 27th ASTE Semiannual Meeting. Copies of the paper may be purchased from Society Headquarters.

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ADVANTAGES OF PLASTICS make it not only useful as a tooling material, *Fig.* 1, but in some cases, the only practical material. This is especially true in the aircraft and missile industry where many large tools must be produced for limited production runs and lead times are short. Plastics tools are light in weight, do not scratch aluminum, require little machining and require less area for building. In addition, curves and compound contours are easier, quicker and cheaper to make with plastics than with steel.

The range of application for plastics tools is almost unlimited. In addition to dies and gages, templates, workholders, drill shells and a number of other tools can be made of plastics. Included here are examples of tools and how they are made.

***Senior member ASTE San Diego chapter.**

Fig. 2. Plastics female master. From this master, gages and other tooling are made. This process saves the plaster master from deterioration or damage.

Tooling Masters: Tooling in the aircraft industry is built around a plaster master, sometimes called a production mockup. The mockups are built by mounting a steel plate on a base or table and machining it flat. After leveling, all station lines are scribed on top and hidden templates located and fastened. The mockup is then finished in plaster. All station lines, door openings, hinge lines and important tooling holes are located on this mockup. All tooling for the assembly is made and coordinated to the master to get the proper interchangeability among the family of tools and production parts.

To save the plaster mockup from deterioration, a master gage is made of plastics; tooling gages, checking gages, drill shells and other tools are made from the plastics master gage. The plastics master gage is made from a female casting or laminate of the mockup. This female can be either a plaster splash or a plastics laminate, *Fig.* 2.

Mockups: Plastics can be used to advantage for parts of full-scale engineering mockups. Many times parts made of cast or reinforced laminates can be produced easier and cheaper than wood or metal. When the mockup must be transported, the light weight of plastics makes construction entirely of plastics practical.

Patterns: Produced in plastics, patterns can be good substitutes for fragile materials. A good method is to make an original cope and drag plaster pattern. A plaster mold is made from each of these. Gel coats of resin and tooling cloth are applied to the molds. The two halves are put together, the edges sealed with tape and the proper casting resin poured in. The resin should be poured through a tube with the mold vented to the air. This allows the resin to enter at the bottom, reducing the chance of trapping air in the casting.

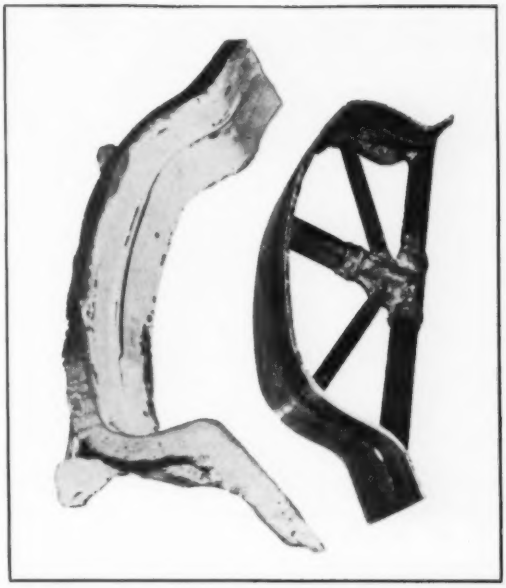


Fig. 3. Blue block made of laminated plastics and reinforced with plastics tubing.

Blue Blocks: Plastics are often used for blue blocks instead of plaster, particularly when the plaster block would be too fragile because of size or configuration or the grinding operation is especially long. A good example of one type being used

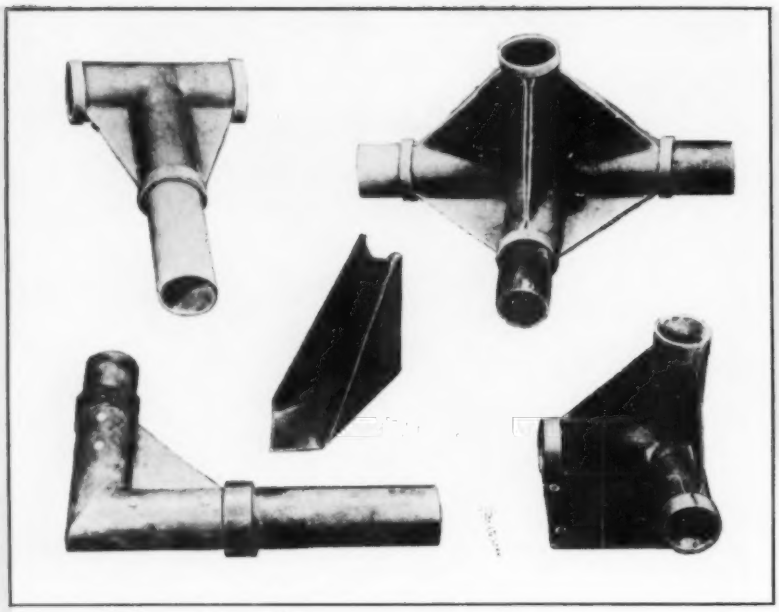


Fig. 4. Various types of fittings available for use with plastic tubing for reinforcement.

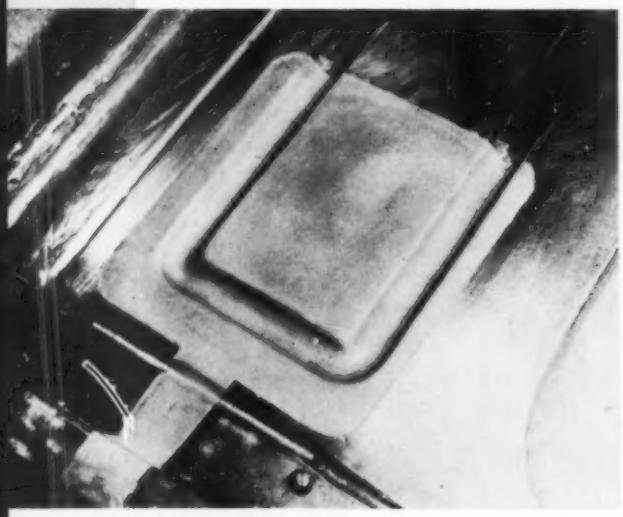


Fig. 5. (left) Drop hammer altered to facilitate a faster engineering change. Material for patch is Epocast 4 B.

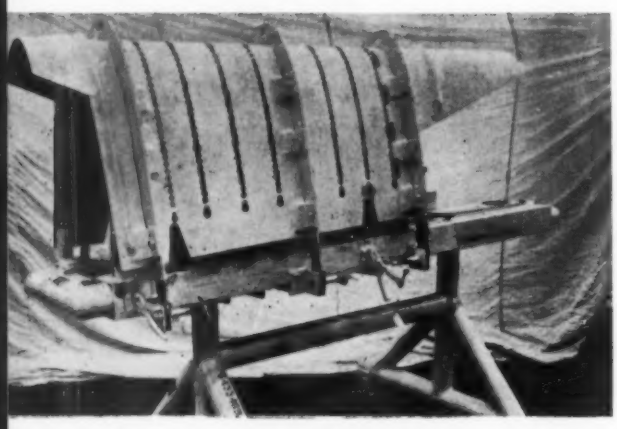


Fig. 6. (below) Drill shell on an assembly jig. Shell is made from plastics. Approximately 500 bushings are contained in the shell.

is shown in *Fig.* 3. Laminations are applied over a face coat, then reinforcement is applied. The reinforcement can be made of plastic pipe and fittings, *Fig.* 4, or sheets of cloth laminated to provide egg-crate or gusset type reinforcement. Rejected aluminum tubing can also be used for reinforcement if the portions at the lamination are sandblasted just before the operation.

Drop Hammer Dies: Many dies for drop hammers can be built easily and cheaply by using plastics for facing material. When dies are constructed in this manner, hand grinding and matching are eliminated. The face is cast on the die using a plaster pattern, employing a special hard casting resin to withstand shock. Resilient resin is the cast on the punch using the die as a pattern.

When facing metal dies, the surface of the metal must be clean and dry. Best results are obtained if the metal is sandblasted just before the pour. After sandblasting, the surface should not be touched. The plaster pattern must be dry and smooth. It is easier to get imperfections out of the pattern than the finished tool. The pattern is placed about $\frac{3}{8}$ to $\frac{1}{2}$ inch from the metal. One end of

Fig. 7. One-half inch aluminum honeycomb is used in this drill shell to give strength and keep weight down.

the die is raised so the plastics can be poured from the bottom. Adequate vents at the top help to avoid air pockets. Dies can also be altered easily with plastics, *Fig.* 5. The section of the die to be changed is roughed out and plastic is poured into the die against a pattern.

Drill Shells: Extensive use of plastics is made for drill shells, *Figs.* 6 and 7. Bushings may be potted in the laminations. To do this, oversize holes are drilled in the shell where the bushings are to be located after curing. The shell is replaced on the plaster pattern or the coordinating tool and the bushings are potted in. An alternate method is to punch holes in the dry cloth and laminate the bushings in. Potting is best if bushings are subjected to heat or rugged use. If the bushings are sandblasted before potting or laminating, retention is considerably improved.

Gages: Master and tooling gages can be made cheaply and quickly with plastics, *Figs.* 8 and 9. Paper or aluminum sandwich is used to make tooling light in weight. To make an inspection fixture for a flanged part, *Fig.* 10, a base is cut out of honeycomb panel and a template placed on it. A prepared tooling template, or locator, is placed on edge against the first template. These locators have holes punched in them or have sheet metal screws through so that plastics will adhere to them. A piece of split rectangular tubing is placed over the locators. Plastics is poured into the tubing and around the locators. After the plastics hardens the tubing is removed. Fixtures of this type can be used to check flatness, contour, perimeter, flange width or part lengths.

Fig. 8. Tooling gage of plastics made from a plastics master. Other tools are also made from master.

Workholders: Chucks and workholders are easily made from plastics, *Fig.* 11. They may be made from solid plastics or may have cast or welded metal backing with resin facing. Normally it pays to make spinning chucks of plastics if the workpiece is irregularly contoured, if the chuck is too large to make out of one piece of metal or if a pattern to pour against is available.

If the part has a straight taper with perhaps a small radius it is probably cheaper to make the

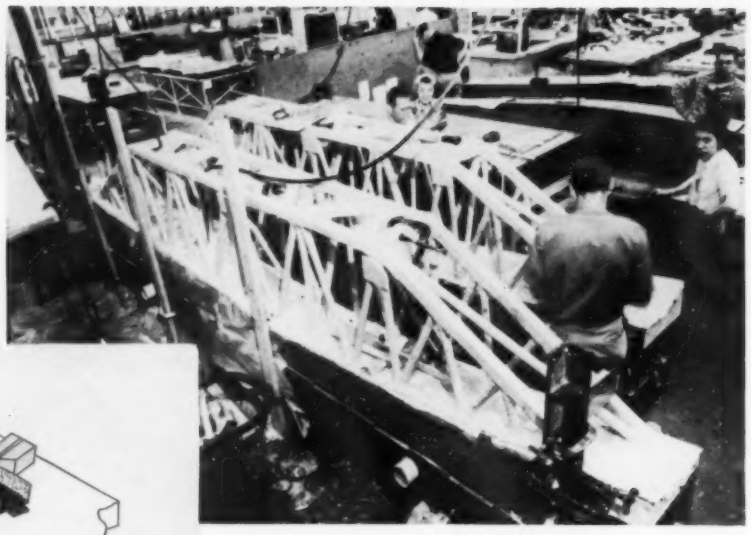
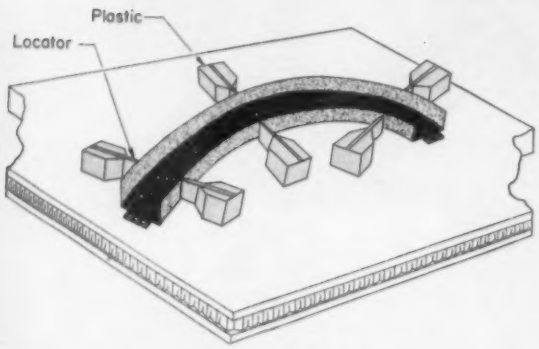


Fig. 9. Master gage for wing stub splice plate. It is fabricated with gel coat, laminations and reinforced plastic pipe.

Fig. 10. (below) Checking device is built up on flat honeycomb sandwich base. Locators are attached with plastics.



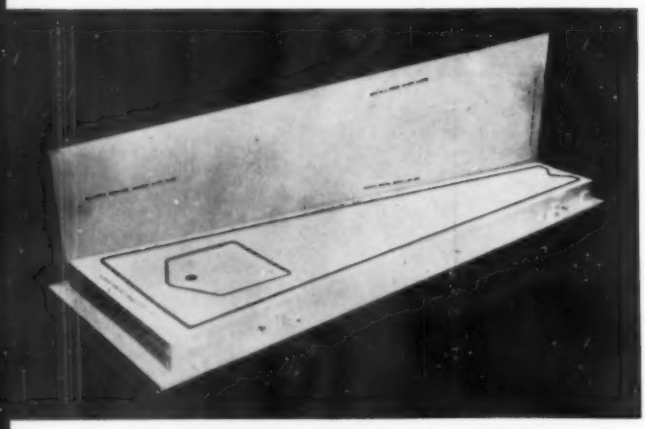


Fig. 11. Vacuum chuck used on tapered skin mill. Material is Epocast 7 A and Epocast 2 A.

chuck from metal on a lathe. When irregularly shaped castings or forgings must be processed in a lathe or boring machine, a plastic workholder poured against a pattern or part works very well for a workholding device.

Other Applications: Keller models or patterns made of plastics are more rugged than plaster. These are commonly made by applying a gel coat and then laminating two or three cloths against a plaster splash or coordinating tool. After the plastics gets tacky or hard, it is backed up with a mixture of 90 percent lightweight sand or aggregate and 10 percent resin.

Plastics replaced a paint template made of paper for final assembly painting on a jet aircraft. The brown paper was placed over the opening for a mask. Occasionally the air pressure of the spray gun caused the paper to rupture. Cleaning up was costly and time consuming. A laminated plastics shell was constructed. This was suitable except that it weighed 35 pounds and was considered too heavy. A new template was made by applying two cloths on each side of a $\frac{1}{4}$-inch honeycomb. The edges were built up with 1 inch wide tape to $\frac{3}{16}$ inch thick. The second mask weighed twenty pounds and performed well.

An interesting and highly successful use of epoxy plastics is construction of surface plate tops. A steel table is welded up and sandblasted. This table is placed upside down on a prepared surface table with $\frac{3}{8}$-inch spacers under it. A casting epoxy is then poured into the space. This type of table is as flat as the original, is light, inexpensive and can't rust. Larger tables can be made by setting up two or more surface tables, aligning them with optical instruments and then filling in the cracks with plaster or putty. A silicon-base plastic is good for this application since it is tough and hard. Some companies are making tables or bases in this way to build plaster masters on.

The process of making surface tables has been extended to the construction of small working tables for beating out and repairing sheet metal detail parts. One of these tables has been in continuous use for over two years and is still in good condition.

corrected FORM TOOL ANGLES

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WHEN A FORM TOOL is used for a combination forming and facing operation, it is necessary to grind the face of the tool at an angle different from that on the part. Forming a radius on a shoulder and facing, *Fig.* 1, is an example. The combination of rake and clearance angles causes the tool edge to become angularly displaced with respect to the required part conformation. It is necessary to introduce a grinding angle to compensate for the dis-

*Senior member ASTE Springfield chapter.

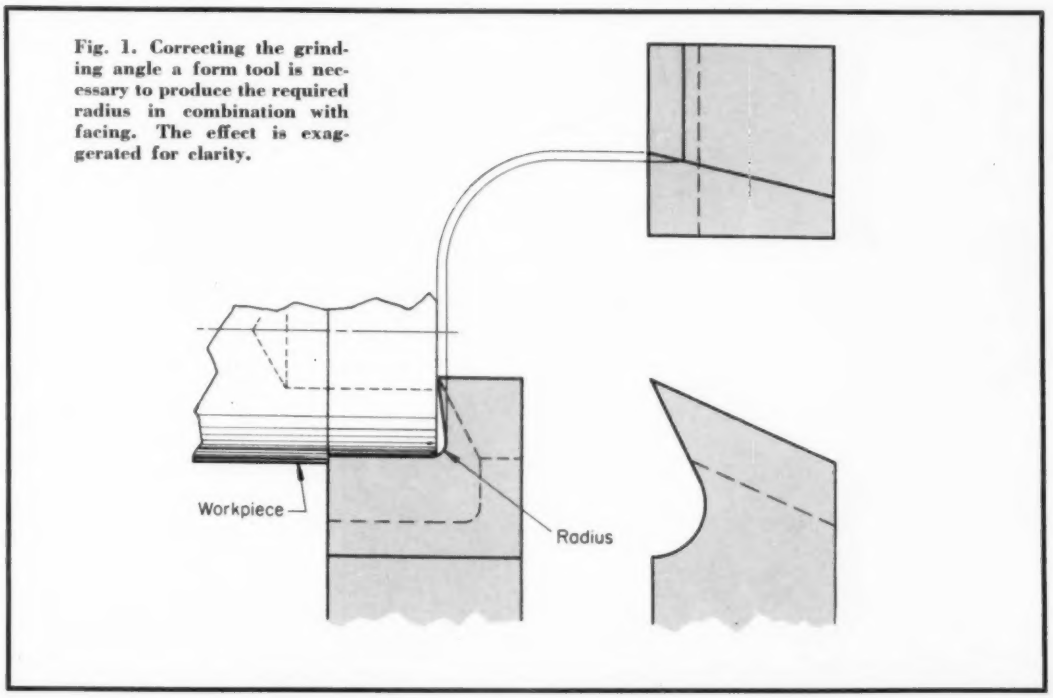


Fig. 1. Correcting the grinding angle a form tool is necessary to produce the required radius in combination with facing. The effect is exaggerated for clarity.

placement and return the tool to proper alignment. This new angle is shown as θ in *Fig.* 2.

The required angle correction formula may be derived as follows:
Referring to *Fig.* 2:

$$b = a \tan(R+C) \tan S$$

where b and a are from *Fig.* 2, R is rake angle, C is end clearance angle and S is side clearance angle.

$$d = b \cos S$$

$$\text{Tan } \theta = \frac{d}{a}$$

$$\text{Tan } \theta = \frac{a \tan (R + C) \tan S \cos S}{a}$$

$$\text{Tan } \theta = \tan (R + C) \tan S \cos S \quad \ldots\ldots\ldots\ldots (1)$$

Since the value of cos S is very nearly one except when very large rake and clearance angles are used, it may be dropped. Equation 1 then becomes:

$$\text{Tan } \theta = \tan (R + C) \tan S \quad \ldots\ldots\ldots\ldots\ldots (2)$$

Corrected angles for a range of rake and front clearance angles and for common side clearance angles have been calculated from Equation 2 and are shown in the accompanying table.

Corrected Angles for Facing Tools*

(R + C)†	Side Clearance (deg)			
	1	2	3	4
10	0°-10′	0°-21′	0°-32′	0°-42′
11	0°-12′	0°-23′	0°-35′	0°-46′
12	0°-13′	0°-26′	0°-38′	0°-51′
13	0°-14′	0°-26′	0°-41′	0°-55′
14	0°-15′	0°-30′	0°-45′	1°-0′
15	0°-16′	0°-32′	0°-48′	1°-4′
16	0°-17′	0°-35′	0°-52′	1°-9′
17	0°-18′	0°-37′	0°-55′	1°-13′
18	0°-19′	0°-39′	0°-59′	1°-18′
19	0°-20½′	0°-41′	1°-2′	1°-23′
20	0°-22′	0°-44′	1°-6′	1°-27′
21	0°-23′	0°-46′	1°-9′	1°-32′
22	0°-24′	0°-47′	1°-13′	1°-37′
23	0°-25½′	0°-51′	1°-17′	1°-42′
24	0°-27′	0°-53′	1°-20′	1°-47′
25	0°-28′	0°-56′	1°-24′	1°-52′

*Angles represent angle θ in Fig. 2.
†Sum of rake angle and end clearance angle (deg)

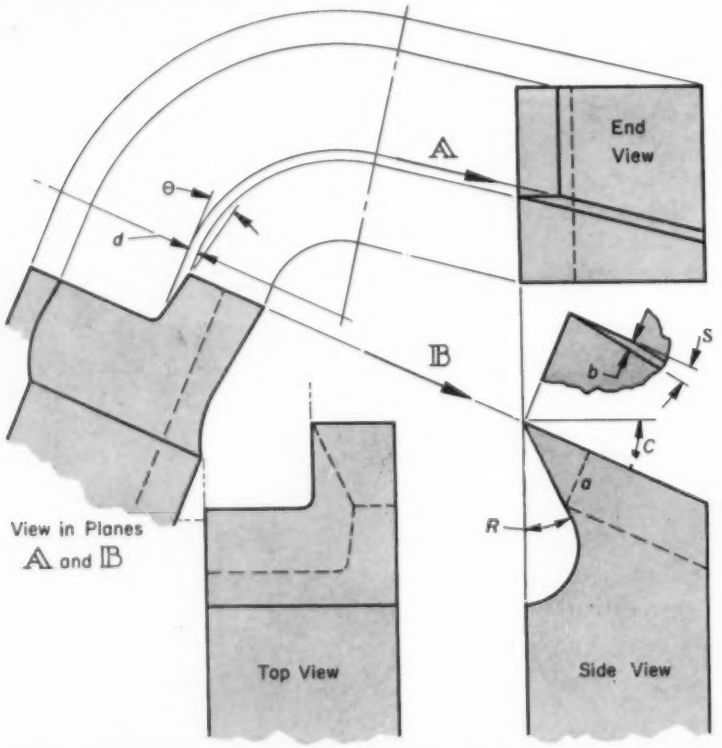


Fig. 2. Correction in the amount of angle θ as shown as projected view aligns the tool edge properly with the required workpiece shape.

ASTE news

Members in the News....126

Spirit of St. Louis....127

Daily Schedule for Convention....128

Chips and Chatter....132

New Tool for the Industry....133

Pittsburgh 'Fixes' a Race....137

Society Members Around the Globe....138

Yugoslav Executives Tour U. S....139

Chapter News and Views....140

Index of Chapter News....141

Members in the News

WILLIAM M. SCRANTON, executive vice president of Miniature Precision Bearings, Inc., has been elected a member of the board of directors. Scranton joined MPB as production manager in 1950; he became vice president in charge of production in 1951; and in 1953 was named executive vice president.

S. HARRY HELLER, member of Greater New York chapter, has been appointed assistant to the president of S & S Machinery Co. Heller, who has held a number of executive positions for other leading tool firms, will concentrate on new equipment design with special attention to dealer relations.

After many years of association with the pump industry in the Midwest, DONALD A. KAESSEN, Los Angeles member, has joined the Sterling Machinery Co. as chief design engineer in their pump division.

The appointment of CHARLES P. SLAVICH, member of Washington chapter, to the position of senior manufacturing engineer has been announced by Weinschel Engineering. Slavich, with experience in all phases of manufacturing, will be responsible for manufacturing procedures in the production of complex electronic instruments.

ARTHUR N. KUGLER, member of Greater New York chapter, who has, since 1929, been associated with Air Reduction Sales Co., a division of Air Reduction Co., Inc., has completed two welding texts which will be used in a welding correspondence course offered by the International Correspondence Schools, Scranton, Pa. The texts, *Fundamental Welding* and *Safety in Welding and Cutting*, are part of a projected 12-book series to be written by Kugler. He has also written numerous articles on oxyacetylene and arc welding.

MALCOLM J. JUDKINS, Pittsburgh, a pioneer and an authority in the nuclear energy field as a result of his association with Los Alamos, Westinghouse Atomic Power Div., and other AEC organizations, has been appointed technical director, commercial production engineering, of Sylvania-Corning Nuclear Corp. Judkins is the author of many articles in scientific and trade publications, and lectures widely at technical societies and educational institutions both here and abroad.

L. F. Joseph

D. A. Kaessen

C. P. Slavich

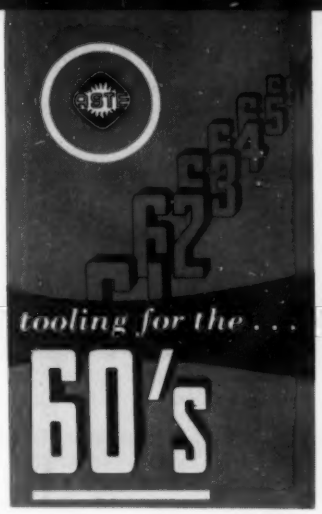
Two of Milwaukee chapter's officers have been promoted by Centralab, a division of Globe Union, Inc.: JOSEPH MUNDBROT, chairman, to manager of capacitor manufacturing engineering; and JOHN A. GASIOROWSKI, chairman of the education committee, to manager of variable resistor manufacturing engineering.

After 25 years of service with Firth Sterling, Inc., W. E. MONTGOMERY, past chairman of Pittsburgh chapter, has been promoted to chief engineer, carbide. In his new capacity Montgomery will be responsible for the phases of engineering which include sales, process, design, application and development.

ROBERT BATHE, St. Louis member, has been promoted to plant manager at the Century Electric Co. Formerly quality assurance manager at the St. Louis factory, Bathe will assume his new position at a new fractional horsepower motor plant being readied for production at McMinnville, Tenn.

ROBERT W. SCHOEFFLER, member of Fox River Valley chapter, associated with Marshall & Huschart for the past 10 years, has been appointed field sales manager. Previously active in the machine tool industry for more than 15 years, Schoeffler will coordinate all field sales and service activities for the company. . . . ROBERT H. SEVERANCE, North Texas, has been appointed district representative for the states of Oklahoma, Arkansas, Texas and Louisiana by Severance Tool Industries, Inc. For 10 years he acted as plant superintendent at their main plant and has for the past 18 months been in the sales and service field in Texas, associated with engineering and industrial supply firms. . . . After 15 years' experience in the cutting tool field, LEONARD F. JOSEPH, member of Detroit chapter, has been appointed Michigan factory representative for Unimet Carbides, division of United Greenfield Corp. Unimet is headquartered in Chicago.

Spirit of St. Louis Soars for Society



THE SPIRIT OF ST. LOUIS will soar to a space-age high when ASTE members—promoting the theme of "Tooling for the 60's"—descend upon that city's Chase-Park Plaza Hotels early this month. The occasion for this landing of tool engineers will be their Society's Semiannual Meeting.

Beginning the evening of Wednesday, Oct. 7, with the St. Louis Day Dinner, the meeting will feature the usual technical sessions, plant tours, social activities, and meeting of the national directors and membership. But in addition there'll be St. Louis' own peculiar blend of atmosphere—a great-city mixture of industry, opera, Lindbergh, the 1904 fair, river boats, the *Post-Dispatch*; a rich history that goes back to 1763 when the city was settled, appropriately enough, by an engineer named Pierre Laclede Liguest; a thousand other things; and a million people.

Adding special conviviality during the ASTE meeting will be the city's Festival of the Veiled Prophet, established in 1878 and rivaling in pageantry the Mardi Gras of New Orleans and the Mummers Day parade in Philadelphia.

Perhaps the most important ingredient of any national ASTE gathering, however, is the unscheduled "conferences" that take place in the hotel coffee shops or lounges, outside the meeting rooms, on the bus heading for a plant tour, or even over the main course at one of the dinners. These informal meetings of members, usually from different parts of the country and working in different phases of tool engineering, are perhaps as much the stuff of "Tooling for the 60's" as the best of many good papers to be read at the 12 technical sessions.

Dr. Ross M. Trump

The first event of the meeting, the kickoff dinner, will spotlight Dr. Ross M. Trump as a keynote speaker. Trump is the dean of Washington University's school of business and public administration. Receiving his Ph.D from Ohio State in 1947, he taught at that university and at Tulane before coming to St. Louis and Washington U. in 1949. Serving as a consultant to many businesses in the field of management development, Trump has achieved international prominence. He is the vice president of the American Association of Collegiate Schools of Business, and has twice represented the United States as a delegate to the International Conference on Management Education. Trump will be addressing his audience shortly after returning from a round-the-world trip, so his talk should contain more than a few interesting references to business and industry in foreign lands.

The next day, Thursday, will open with the Board of Directors meeting, at which all members are welcome. The directors will act on recommendations presented in the semiannual reports of the various committees, and transact other business of the Society.

Half an hour after the board convenes, the first of 12 technical sessions gets underway. A complete schedule of the day-to-day events—the sessions, the tours, the social gatherings, the ladies' activities—begins on the next page.

Wives shouldn't have any trouble keeping busy while their husbands are attending sessions, tours and meetings. The St. Louis Ladies' Activities Committee, consisting of 16 women and one man, Chairman Erwin P. Huchzermeier, has outlined a schedule of events to keep the ladies in a proper whirl. The wives of St. Louis chapter members E. P. Huchzermeier, I. J. Schumaier, Richard D. Bardes, Clarence L. Miller, Charles Hawkins, C. A. Brown, Ray Kallemeier, Rudy Kick, Orvell Essman, William Scheublein, Jr., Kenneth Ritter, Glen Dilling, Edgar L. Messmer, Ralph F. Mueller, Willis Potthoff, and a member in her own right, Miss Paulena Pagel, have been recruited to handle the women's activities.

The St. Louis convention seems to be shaping up as one of the most colorful and eventful ASTE gatherings to date. There is little doubt that the technical and social functions will be appreciated by all.

daily schedule of events

St. Louis Semiannual CONVENTION

location:

All events in Chase-Park Plaza Hotels

dates:

Wed., Oct. 7, through Sat., Oct. 10.

registration:

The Hunt Room, Second Floor, Chase Hotel, at these hours:

Thursday,	Oct. 8	7:30 a.m. - 7 p.m.
Friday,	Oct. 9	8 a.m. - 8 p.m.
Saturday,	Oct. 10	8 a.m. - 2 p.m.

An ASTE Headquarters Center, located in the registration area, will be open during registration hours. Complete information on the convention, Society technical publications and free literature on all ASTE activities will be available.

wednesday **october 7**

ST. LOUIS DAY

Dinner and Reception

7 p.m. Starlight Roof

Toastmaster: C. A. Brown
General Chairman, St. Louis Host Committee

ASTE Welcome: Wayne Ewing
President of ASTE

Keynote Speaker: Dr. Ross M. Trump
Dean, School of Business and Public Administration
Washington University

Tickets $7

thursday **october 8**

Metal-Cutting Problems

9:30 a.m. — Chase Club

"Chatter Vibrations as a Stability Problem of Machine Tool Structures" (Paper No. 215), by Dr. M. Sadowy, assistant professor of mechanical engineering, College of Engineering, Marquette University.

"Evaluation of Several Lathe Tool-Life Testing Techniques" (Paper No. 216), by Roy F. Mennell, assistant branch chief; and Edwin A. Jeffery, mechanical engineer, Experimental Machining Branch, Rodman Laboratory, Watertown Arsenal.

Chairman: Henry R. Quante, manager, Stanley Industrial Tool Co.

New Developments

2 p.m. — Chase Club

"Recent Developments in the Theory and Application of Electrical Discharge Machining" (Paper No. 220), by George G. Bott, process engineer, Grumman Aircraft Engineering Corp.

"Recent Developments in Explosive Forming at Grumman Aircraft" (Paper No. 229), by Arthur Wickesser, Jr., manufacturing engineer, Grumman Aircraft Engineering Corp.

Chairman: Wayne C. Bryant, missile project engineer, Emerson Electric Mfg. Co.

Electronics Applied to Inspection Problems

7 p.m. — Tiara Room

"Parts Inspection and Decision Making by Electronics" (Paper No. 231), by David R. Houck, application engineer, Industrial and Machine Tool Operations, Radio Corporation of America.

"Special Electronic Test Equipment and Its Relationship to Mechanical Tooling" (Paper No. 232), by Arthur E. Moxley, project engineer, Test Equipment Engineering, International Business Machines Corp.

Chairman: Joseph E. Rush, owner, Joseph E. Rush Machinery Co.

Handbooks and How to Use Them

(Cosponsored by the National Technical Publications Committee of ASTE)

7 p.m. — Tiara Lounge

"Effective Use of Technical Books" (Paper No. 235), by Frank W. Wilson, technical director, American Society of Tool Engineers.

"Engineering, Scientific, and Technical Handbooks" (Paper No. 236), by Richard P. Zeldin, handbook editor, McGraw-Hill Book Co., Inc.

Chairman: Willis J. Potthoff, supervisor of tooling, electronics and avionics, Emerson Electric Mfg. Co.

Semiannual Meeting of the Society and Board of Directors

9 a.m.-5 p.m. — Regency Room, Chase Hotel

St. Louis

ALL MEMBERS WELCOME TO ATTEND

St. Louis Host Committee's

MONTE CARLO NIGHT

9 p.m. — Tickets - $4 — Zodiac Lounge

friday october 9

Advanced Tool Engineering

9:30 a.m. Chase Club

"Precision Roll Grinding with Coated Abrasive Bolts" (Paper No. 221), by Warren K. Seward, supervising engineer, Product Application and Market Development, Coated Abrasives Div., The Carborundum Co.

"Total Concept of Numerical Control" (Paper No. 217), by William B. Johnson, industrial engineer, chairman, Numerical Control Coordinating Committee, Rocketdyne, Div. of North American Aviation, Inc.

Chairman: William A. Scheublein, Jr., chief engineer, Moog Industries Inc. of St. Louis.

Shop Techniques

2 p.m. Chase Club

"Hand Straightening of Small Parts: Method Improvement and New Tooling" (Paper No. 222), by Raymond L. Jones, associate engineer, Tool Engineering Dept., International Business Machines Corp.

"Techniques for Machining and Welding 6061 (61S) Soft Aluminum Forgings" (Paper No. 223), by Francis X. Bolt, engineering designer, Tool Design Unit, and Bernard Polonsky, mechanical engineer, Manufacturing Engineering Section, Watertown Arsenal.

Chairman: Richard D. Bardes, district manager, Vanadium-Alloys Steel Co.

Importance of Positional Tolerancing

7:30 p.m. Zodiac Lounge

"How Positional Tolerancing Clarifies Design Intent and Reduces Product Cost" (Paper No. 225), by Edward S. Roth, staff member, Sandia Corp.

Chairman: William E. Stuart, Magnesium Sales, The Dow Chemical Co.

Safety and The Tool Engineer

(Cosponsored by the National Safety Council)

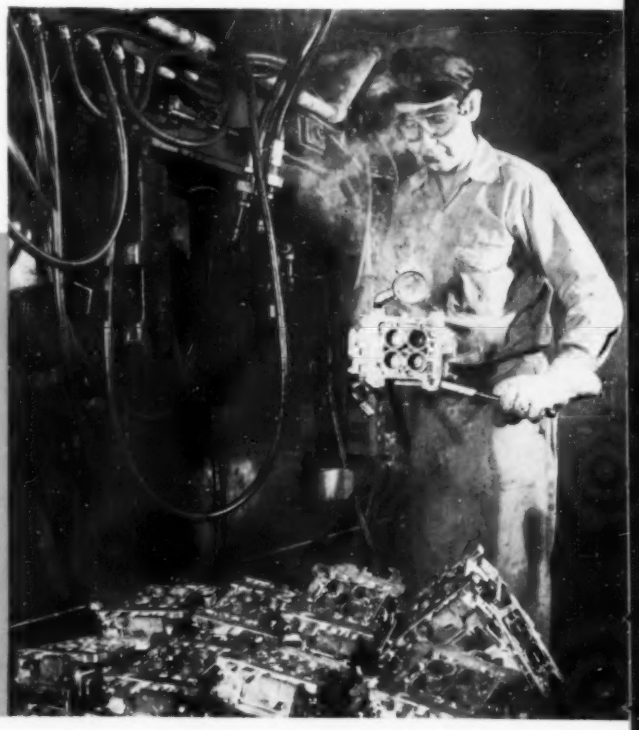
8 p.m. Starlight Roof

"Production Through Safeguarding" (Paper No. 233), by T. A. Kraklow, director of safety, Deere & Co.

"Safety and Production—Die Design" (Paper No. 234), by LeRoy A. Faulkner, director—Industrial Plant Service, Loss Prevention Dept., Liberty Mutual Insurance Co.

Chairman: Arthur S. Kelly, director of technical publication development and staff representative, Power Press and Forging Section, National Safety Council.

This die casting operator at Carter Carburetor examines a complex carburetor body cast of aluminum under pressure of about 33,000 pounds per square inch. Casting, forging, riveting, welding, annealing, tool and die designing and production, and heavy assembly are among the processes carried on at the St. Louis plant.



PLANT TOURS

THURSDAY, OCT. 8

1:15 p.m.—OWENS-ILLINOIS CO.

Limit 100 visitors. New shop makes repair parts and machines for the company's factories.

FRIDAY, OCT. 9

8:30 a.m.—EMERSON ELECTRIC MFG. CO.

Limit 40 visitors. Manufacturing operations of fractional horsepower motors, including shaft turning and grinding and rotor die casting.

1:30 p.m. CARTER CARBURETOR, Div. of ACF Industries, Inc. Limit 100 visitors. Productions, inspection and toolroom operations, including die casting of zinc alloy and aluminum.

saturday **october 10**

Heat-Treating and the Tool Engineer

(Cosponsored by the Metal Treating Institute)

9 a.m. Chase Club

"Special Heat-Treat Techniques—Some Case Histories" (Paper No. 237), by Julius Turk, metallurgist, Paulo Products Co.

"The Heat-Treatment of Tools, Jigs and Fixtures" (Paper No. 238), by Edward J. Pavesic, field metallurgist, Lindberg Steel Treating Co.

Chairman: Ben F. Rassieur, president, Paulo Products Co.

The Tool Engineer and Machine Tools

9:30 a.m. Regency

"Shop Use of Building Blocks" (Paper No. 218), by Robert J. Nist, Machine Tool Section, Hartford Machinery Co.

"Water Uptake Determination in Oiler Felts by Radioactive Tracer" (Paper No. 219), by Dr. Humphrey K. Ezell, Jr., senior scientist, Special Training Div., Oak Ridge Institute of Nuclear Studies; and Dr. A. O. Schmidt of Kearney & Trecker Corp. and research professor, Marquette University.

"Machining of Zircoloy" (Paper No. 224), by Dr. A. O. Schmidt and J. R. Roubik, research engineer, Kearney & Trecker Corp.

Chairman: Orvell W. Essman, acting superintendent, The Measuregraph Co.

Plastics As A Tool Material

1:30 p.m. Regency

"Draw Die Abrasion Resistance Test" (Paper No. 228), by Appy Juras, president, Plastic Development & Research, Inc.; Thomas E. Bugel, development engineer, Engineering Applications Group; and Charles F. Pitt, group leader, Development Dept., Union Carbide Plastics Co., Div. of Union Carbide Corp.

"Practical Applications for Plastic Tools in the Aircraft and Missile Industry" (Paper No. 227), by Alan M. Fullarton, Convair Astronautics, Div. of General Dynamics Corp.

Chairman: Lyle R. Perry, senior tool designer, Tooling Research and Development Group, McDonnell Aircraft Corp.

The Tool Engineer Adds to Profit

2 p.m. Chase Club

"Optimum Tolerances of Sheet Materials for Flight Vehicles" (Paper No. 230), by George A. Hoffman, engineer, Aero-Astronautics Dept., The Rand Corp.

"Rigged for Economy Producibility" (Paper No. 226), by A. Martin Stubel, manager, Engineering Loft, Temco Aircraft Corp.

Chairman: Harry N. May, manager, Magnesium and Accessories Depts., Hubbell Metals, Inc.

DINNER DANCE

Starlight Roof, Chase Hotel

Social hour, 6:30 p.m.

Dinner, 7:30 p.m.

Dancing, 9 p.m. till 1 a.m.

Hal Havird and Orchestra

Dress Optional Dinner – $8

LADIES' ACTIVITIES

Hospitality room and lounge will be maintained by the St. Louis Ladies' Activities Committee in the Colonial Room on the second floor of the Chase. Registration for the convention (no charge for the ladies) at the ASTE registration area, Hunt Room, second floor, Chase Hotel.

Wednesday

7 p.m. A social hour with entertainment and music, Avis Miller Trio, preceding the St. Louis Day dinner and reception.

Thursday

8:45 a.m. Get Acquainted Breakfast
10:30 a.m. Charlotte Peters Show
7:30 p.m. Ernie Heldman Magic Show
9 p.m. Monte Carlo Night

Friday 10:30 a.m. St. Louis Tour

Chips and Chatter

QUOTE OF THE MONTH: "In Yugoslavia, we refer to America as the country where the impossibilities are possible."—Vojislav Bjelicic, one of nine top Yugoslav tool engineers and designers on a State Department-sponsored tour of U.S. plants. Bjelicic, who is chief engineer of the "14 Oktobar" plant in Krusevac which was named for the town's liberation day in 1844, summed up his great expectations of America during a press conference at the group's stop at Adamas Carbide Corp., Kenilworth, N. J.

ROCHESTER chapter member Sherman B. Hagberg rated a four-column salute on the editorial page of the *Rochester Times-Union* recently, as the paper's weekly selection for outstanding contribution to the community. Hagberg, 63, had just retired after 28 years as director of athletics at Rochester Institute of Technology. But he'll stay on at R.I.T. for another year as a mechanics teacher, a post he's held for 40 years.

Hagberg naturally has some definite ideas about sports. He thinks wrestling is the best sport for the young man, sailing for the middle-aged, and swimming for the older man.

He also has some ideas about happiness. "I guess I'm lucky to have had such a good time at work. I've never had a problem I didn't want to face."

It takes no slide rule to figure out that Sonya Morey, 19 and blonde, is a drawing card when she works at her drawing board in her college engineering class. Sonya, who is secretary of the ASTE student chapter at SINCLAIR COLLEGE, Dayton, Ohio, is kept busy mapping out her present and her future. As the first female engineering co-op student at Sinclair, she goes to school for eight weeks and then works for another eight weeks at the county sanitation department, charting maps on sewage and water lines. She's charted a future in tool engineering, too, and one of the shortcuts on her map is plainly marked ASTE. . . .

Despite such classroom scenes as that pictured here, her instructors say, Sonya's presence among a hundred boys hasn't disrupted concentration beyond eventual recall. The world of lathes, milling machines, tools, dies, jigs —and males—is hers to conquer. Her father is a toolmaker but Sonya says, "It's only since I've begun college that he's started to talk about it to me. He helps me with my homework now."

Out of the many pictures taken at the many golf stags and picnics that livened the many ASTE chapters during the summer doldrums, this one was irresistible. When LOUIS JOLIET chapter (Joliet, Ill.) held its stag, Chapter Chairman Don Domnick teed off mightily, but no one was sure in what direction. The photo would indicate that Milton Jensen thinks the ball went thataway, Lou Princis thinks it was a vertical drive, and Ray Bachman just doubts whether Don hit it at all. But after the Joliet jollity, the group was ready for serious business—such as an on-campus conference Oct. 30-31.

new tool for the industry: metal cutting bibliography finished

by M. L. Stone, news editor

BIBLIOGRAPHY, a dreary word, conjures up nothing exciting in the minds of most people.

Its power is underestimated.

In the hands of a student or a scientific investigator, or simply a man with a purpose, bibliography becomes a magic and indispensable guide not only to what is known about a given subject, but also to what is not known.

It is the starting point of any investigation of any subject, the vital auxiliary of every science and art. Where no bibliography exists, the investigator's first task is to compile his own, as a guarantee that he will not needlessly do again what has already been done. . . .

The lack of an authoritative and comprehensive bibliography has sorely hampered progress in metal cutting at least since 1943, the termination date of the last previous special compilation on the subject. That such should be the case—in a science which must, of economic necessity, be as far removed from hit-or-miss methods as possible—is an incongruity of glaring proportions which the ASTE early recognized.

The Society set about bridging this chasm in tool engineering knowledge in 1955, through the instrumentality of its Research Fund Committee. Results are now at hand.

A bibliography of metal cutting—known as Stage One of ASTE's ambitious multistage Metal-Cutting Research Project—has been completed after nearly four years of intensive work by experts at the John Crerar Library in Chicago. It will be published, probably in a two-volume set, by the Research Fund Committee as soon as contractual arrangements have been settled.

Launching Pad for Progress

The ASTE's contribution of a metal-cutting bibliography is as exciting as a new tool, and potentially much more significant. When used as a research tool, the bibliography should be worth much more than the $42,000 that it cost to produce. It should reinforce materially industry's efforts to whittle the staggering price ($10 billion a year) of making chips. It should serve, too, as a beacon light in the Society's continuing long-range program for metal-cutting research that may cost a million—and may save billions.

Particularly the bibliography will abet ASTE's "Stage Two" contribution to metal-cutting knowledge, the highly praised "Evaluation of the Present Understanding of Metal Cutting" which was published last February as the result of a two-year study by staff analysts of the Battelle Memorial Institute. Crerar work, in fact, formed the nucleus of the Battelle project. The library furnished references on which the Evaluation was based.

Together the two works are of basic importance: they will help form a launching pad for space-age progress. . . .

As provocative as its potential is, no less so is the story of how the bibliography was compiled. This

Research associates at John Crerar Library in Chicago, Drs. Leon Marshak and Rose Mittelmann, review a Russian article on microfilm.

writer visited the Crerar Library to see first-hand what he expected to be merely an arid collection of annotated cards. He found the cards, all right—over 6000 of them, size 5x8. But between the cards, so to speak, he found a record of word sleuthing that contained as much plot, character, and motivation as a romance.

One of the earliest bibliographies dates back to the mid-Sixteenth Century. When Conrad Gessner, a Zurich physician, set out on the even-then formidable task of assembling his *Bibliotheca universalis*, he couldn't have faced in the whole world more

Ammiel Prochovnick, research associate closely identified with the ASTE project, edits, codes and indexes a group of abstracts. Behind him are boxes of cards for the 27,000-entry subject index.

written material than the Crerar staff confronted when it approached the narrow field of metal cutting, 1943 to the present. For our highly literate civilization produces words like chips, and the pulling together of all recorded data on any subject is an appalling challenge.

Choice of the Crerar Library to meet the challenge was well-advised. The nonprofit facility, founded in 1895, is the country's largest research library devoted exclusively to science, technology, and medicine. Its million-volume aggregation contains 65,000 on engineering, and it keeps complete and running files of 10,000 periodicals from all over the world. The staff of the library's Research Information Service, to whom the ASTE project was specifically assigned, has training in nearly all scientific fields, with strength in chemistry and physics. One man alone has competence in more than 20 foreign languages. The staff also brought years of directly applicable experience to the job, having handled nearly 3900 bibliographic projects for industry, government, associations and individuals.

The ASTE committee's assignment to Crerar was to the point: a well-organized, carefully screened, indexed bibliography of all writings on metal cutting published since the cutoff date of the O. W. Boston bibliography, complete with specially prepared abstracts. The Research Fund Committee, for purposes of this project only, defined metal cutting as including those operations producing a chip—turning, milling, tapping, boring, etc., but not shearing, punching or flame-cutting. Exceptions to the definition arose almost immediately, however. The scope of the project was stretched to include electro-erosion, ultrasonic machining, and certain other processes such as fine-grinding techniques where the chip-forming characteristics are a matter of dispute.

The first and most laborious phase of the preparation was the search for the original writings. This involved careful checking of some 30 indexing services, of both general and specialized contents, for the years assigned. Some 80 percent of the references were immediately available for reading because they were in the Crerar stacks. The thousands of items thus located formed the basis of the work.

But the staff did not anticipate the amount of material not indexed at all, or the general incompleteness of indexing services. It found, as the tedious months rolled by, that from 25 to 30 percent of applicable material was not indexed anywhere. Footnotes, allusions, internal bibliographies and other secondary sources yielded article after article, until the original estimate of 8000 citations grew to better than 18,000. Most of the obscure references were obtained on microfilm or on loan from various university and special libraries in this country, Canada, Europe, and Japan, but some searches took on cloak-and-dagger aspects. This was especially true in the hunt for wartime publications in Germany and Russia, many of which on perusal turned out to be high-quality contributions to the field. For example, out of three major foreign journals not indexed anywhere, the Crerar staff gathered —through agents working in those countries—300 articles from the German, 200 from Russian, 100 from the Swiss.

34 Versions of One Article

Neither did the Crerar people foresee the amount of duplications they would have to wade through. These were encountered in the stretch drive of the project, when they attempted to list together under the original publication all articles based upon it which were essentially repetitive.

Roger ("Mac") Martin, one of the key start-to-finish workers whose relaxed frame, easy grin, cowboy boots and Texas talk conceal a burning dedication to the world of words, told this story of his most extreme encounter with article duplication:

"I first became aware in early 1957 that this article was cropping up again and again in various journals. Good meaty article, too. Once alerted, I started keeping a lookout—and keeping score. By the time we finished, I had read essentially the same article in 34 versions of the original.

"The original?" Mac grinned and said he was glad to oblige. "But first let me say that we arbitrarily regard the first appearance in print as the original. It's the principal citation, and subsequent similar appearances or versions are carried on the abstract card in question as 'see also.'

"The famous article in question was presented first as an ASTE paper, and originally appeared a decade ago in THE TOOL ENGINEER."

Martin's illustration points up another problem faced by Crerar, one that delayed the completion of the bibliography. It was the sort of project that had to be finished by the starters. The library couldn't switch pivotal personnel in midstream, or even add people when it realized fully the colossal size of the job, for so much of the finish—the editing and tying together of loose ends—depended on the memory of the beginning workers.

The boss at Crerar, Chief Librarian Herman H. Henkle, in explaining the prolongation of the project from the originally estimated two years to four, wrote ASTE Research Director Leslie S. Fletcher:

"Efforts were made to try to draw others into the editorial activity with the result in a drop of quality that Messrs. (William S.) Budington and Martin were convinced was not admissible."

"There was no sacrifice of quality to expediency," he said later. "As a result, the bibliography is better by far than we envisioned at the start. It's the best bibliography, in short, that we could make it—the best thing we've ever done."

Such a statement carries weight when it comes from Henkle, an affable, pipe-smoking, bristly-haired expert who learned his business during years at the Library of Congress under tutelage of the poet-playwright and arch-librarian, Archibald MacLeish. Henkle came to Crerar 12 years ago, and since then has added both stacks and stature to the already towering reputation of the 15-story library at the corner of Randolph and Michigan, in the heart of Chicago.

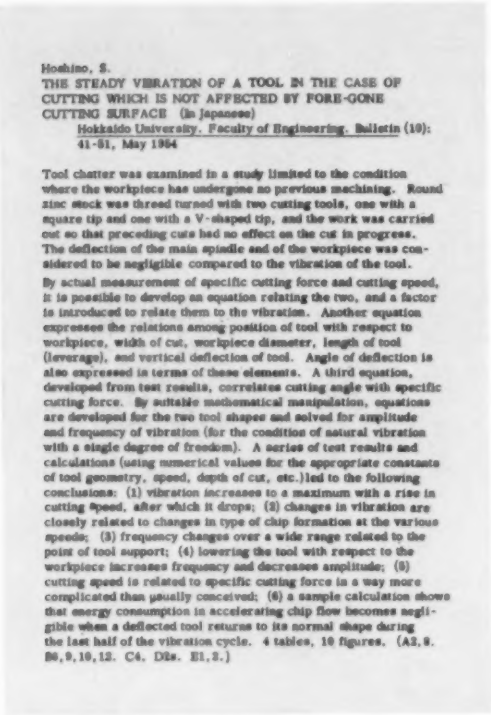
After searching, subsequent steps in the bibliography compilation were examination and abstracting. Staff members read each original writing to determine whether the information lay within the scope of the project; if so, they prepared brief abstracts in English. Length of the abstracts varies, depending wholly on the staff member's editorial judgment of the value of the material. ASTE gave the Crerar editors complete leeway in the selection

William S. Budington, associate librarian, and Roger M. Martin, assistant manager of Crerar's Research Information Service, look over finished copy of ASTE's metal-cutting bibliography.

and editing process. The abstracts are not mere descriptions of the articles, but include the principal elements and experiments and the principal conclusions of the author. Editorializing was strictly outlawed; the only editorial judgment brought to bear was in the weeding out of duplications. This tying-together process reduced the number of abstracts from 9200 to 6000.

Abstracts Grouped, Indexed

After being typed on master cards using IBM proportional spacing machines, the references and their abstracts were grouped according to cutting process (of which there are 15 categories), subdivided according to theoretical or experimental content, shop-practice application value, and general information.



Hoshino, S.
THE STEADY VIBRATION OF A TOOL IN THE CASE OF CUTTING WHICH IS NOT AFFECTED BY FORE-GONE CUTTING SURFACE (In Japanese)
Hokkaido University. Faculty of Engineering. Bulletin (10): 41-51, May 1954

Tool chatter was examined in a study limited to the condition where the workpiece has undergone no previous machining. Round zinc stock was thread turned with two cutting tools, one with a square tip and one with a V-shaped tip, and the work was carried out so that preceding cuts had no effect on the cut in progress. The deflection of the main spindle and of the workpiece was considered to be negligible compared to the vibration of the tool.

By actual measurement of specific cutting force and cutting speed, it is possible to develop an equation relating the two, and a factor is introduced to relate them to the vibration. Another equation expresses the relations among position of tool with respect to workpiece, width of cut, workpiece diameter, length of tool (leverage), and vertical deflection of tool. Angle of deflection is also expressed in terms of these elements. A third equation, developed from test results, correlates cutting angle with specific cutting force. By suitable mathematical manipulation, equations are developed for the two tool shapes and solved for amplitude and frequency of vibration (for the condition of natural vibration with a single degree of freedom). A series of test results and calculations (using numerical values for the appropriate constants of tool geometry, speed, depth of cut, etc.)led to the following conclusions: (1) vibration increases to a maximum with a rise in cutting speed, after which it drops; (2) changes in vibration are closely related to changes in type of chip formation at the various speeds; (3) frequency changes over a wide range related to the point of tool support; (4) lowering the tool with respect to the workpiece increases frequency and decreases amplitude; (5) cutting speed is related to specific cutting force in a way more complicated than usually conceived; (6) a sample calculation shows that energy consumption in accelerating chip flow becomes negligible when a deflected tool returns to its normal shape during the last half of the vibration cycle. 4 tables, 10 figures. (A2, 8. B6, 9, 10, 12. C4. Dis. E1, 2.)

Here's a finished copy of an abstract as it will be published in book form. Note that the reference in this case was obtained from Japan.

The staff tried to place those operations together that use similar tools, but as usual had to make some exceptions. For example, an article on a threading operation done with a single-point tool was indexed under turning rather than threading, because it was the abstractor's judgment that the main interest would be in the tool itself rather than the threading operation.

Finally, separate author and subject indexes were prepared. The indexes referred by serial number to each reference card. Subject indexing was made complex by the fact that a single article often covered several, occasionally all, of the 15 cutting operations.

A nagging problem that arose in editing and indexing was the "tremendous variation in terminology," according to Martin. Superfinishing, for instance, means one thing in the United States, something else in France, something quite different in Germany.

"We decided that as far as possible we would stick to the author's definition of a controversial term," Martin said.

Adaptable for Punched Cards

A distinctive feature of the metal-cutting bibliography will be its adaptability. The final book pages will be printed by photo-offset, using the overlapped cards as master copy. The system will also make it possible to reproduce the bibliography in the form of cards for those wishing such a file. The cards are code-correlated with an adaptation of the ASM-SLA Metallurgical Classification, enabling integration of the bibliography with a file system using this classification.

It's here that automation enters the literary field. According to Budington, who was the man directly in charge of the ASTE project, presence of the precoded notations will assist in adapting the biblography for punched card and other automatic literature-searching apparatus, eliminating tedious index checking and producing bibliographies rapidly and electronically.

That the ASTE committee is pleased and impressed with the library's work was underlined by a recent financial adjustment. Crerar's original fixed bid was $28,200 plus a $3060 fee for perusal extension. But due to the length and complexity of the project, Henkle found in a final accounting that Crerar stood to lose $11,000. The ASTE made it up.

Henkle is proud of the finished product and is sure that the ASTE will be, too. As a result of the long association of his staff with the ASTE, he also is unreserved in his admiration for the American Society of Tool Engineers.

With one exception.

Henkle can't understand why the ASTE has no plans to "keep the ball rolling" on such an important contribution to the industry. "Current perusals, by some qualified agency, should be on a continuing basis. Writings coming out today are more easily located today than they are ten years later."

The cutoff date of perusals in the ASTE's bibliography is September 1956.

PITTSBURGH 'Fixes' a Race

YOU CAN'T DEPEND on horse and buggy methods to meet the pace of modern industrial requirements.

No one in America knows this more than the tool engineer—and perhaps no ASTE chapter in America is more acutely aware of its truth than the one in Pittsburgh, the city with steel sinews.

Nevertheless, tool engineers of Chapter 8 are going to test their philosophy of progress on Nov. 6, by staging a handicap race between a horse and buggy and a modern automobile. They are so confident of the outcome that they've prepared an elaborate celebration at the Penn-Sheraton Hotel, featuring the unveiling of a plaque by ASTE President Wayne Ewing and an hour-long television broadcast over station WQED to the two-million-plus people in the Pittsburgh area.

The auto will reign over the horse and buggy, says the script.

The ASTE spectacle will be staged in conjunction with Pittsburgh's Bicentennial and will climax the chapter's four-week seminar on punches and dies starting Oct. 5 at Carnegie Tech.

According to Elwood Weissert, chairman of the chapter TV promotions committee and author of the script, a horse and buggy will leave the Duquesne Light Co.'s Atomic Power at Shippingport, Pa., early on the morning of the 6th. The driver will be carrying a steel stamping, an integral component of the lighting circuit in the commemorative plaque to be unveiled that evening by President Ewing. At 3 o'clock in the afternoon, the horse and buggy's competitor in the handicap race, a modern automobile, will zoom away from the starter mark in Shippingport. The auto's driver will be carrying a titanium stamping, also a vital part of the circuit.

The plaque to be unveiled on the TV show will be in two panels. The stamping carried by horse-and-buggy methods will be needed to illuminate the panel showing Pittsburgh 200 years ago and bearing the legend "Take What You Have." The stamping carried in the modern auto will light up the other side of the plaque showing the Pittsburgh of today and the words "Make What You Want."

On the TV screen will be seen the auto driver winning the race by inserting his stamping in the circuit.

So far, so good. But the horse and buggy, according to script, will be unable to finish the race in time for the unveiling. To maintain the link with the past, an ancient automobile will be cranked up and dispatched to contact the buggy driver. They will meet at a point below the McKees Rocks bridge, and the old-time auto will chug up to the finish line just in time for the unveiling.

Aside from all the horseplay, Weissert says, there will be a good deal of horse sense in the chapter's televised approach to its community. The program will give viewers a graphic short course in punches and dies.

Presses, from small ones to 15-ton, will demonstrate how punches and dies "have the power to make every man a king."

The program, in short, will point up the essential function of the 600 ASTE members in Pittsburgh, which is to build for the future by improving the conditions that existed in the past.

SOCIETY members found around the GLOBE

By Elizabeth R. Rooney
assistant to news editor

THE SUN NEVER SETS on the American Society of Tool Engineers.

From Poona, India, to Belgrade, Yugoslavia; from Tel Aviv, Israel, to Belfast, Ireland; from Tokyo, Japan to Vereeniging, Transvaal, South Africa—there is always a tool engineer on hand. Almost as far-reaching as the field of tool engineering itself is the distribution of ASTE members across the earth.

As of July, 1959, membership in the Society totaled 40,031. Of this number, 2,810 were in other lands. Our northern neighbor, Canada, claims 1867 members, and 820 Society members inhabit that island continent, Australia. The next largest concentration lies in Cuba, where 111 creative manufacturing specialists work and live and belong to ASTE. India and Mexico have 31 apiece, and England and South America each claim 22. The rest of the foreign members are scattered throughout various countries such as Pakistan, China, Thailand, Jamaica, Scotland, and Lebanon.

The majority of these men are members-at-large; they do not belong to any particular chapter, simply because none exists in their locale. But, knowing the advantages and prestige that go with it, they have applied for and received membership in the ASTE.

Reviewing a list of those members-at-large who contribute to the Society's international flavor is like reading a roster of the delegates to the U.N. Take Mr. Shochi Kuroda, for instance. He joined the Society last March, becoming the fifth ASTE member in Japan. Kuroda became president of the Kuroda Gauge Mfg. Co., Ltd., when his father passed away. The firm specializes in the manufacture of gages, dies, and precision instruments. Educated at Tokyo University, Kuroda eventually received his bachelor of engineering degree there.

Representing the Union of South Africa in this lineup of foreign members is Michael Gandy. He became a member just one month earlier than Kuroda. The colorful name of Gandy's home town sounds like a setting for a Hemingway story—Three Rivers, Vereeniging, Transvaal, South Africa. The firm of South African Farm Implement Manufacturers, Ltd., is located there and Gandy is the manager of its manufacturing division. He received his mechanical engineer's certificate of competency at Witwatersand Technical College. An interesting side light in this tool engineer's career is the fact that before joining his present employer he worked as an apprentice engineer in an African gold mine.

A captain in the Israeli Defense Army provides another random sample of a tool engineer at work abroad. Ephraim Vadas, stationed at Tel Aviv, works as a mechanical engineer for his country's military force. Naturally, the nature of his work is classified. Captain Vadas became orientated in the mechanical engineering field at the Royal Hungarian Technical High School in Budapest. A registered professional engineer in Israel, he joined the Society in late 1957.

Poona, India's claim to ASTE fame is Mohan Babrah, member-at-large since 1958. Superintendent in the machine shop of Reestori Horusby, Ltd., Babrah was formerly with Hindustan General Electric Corp. in Karampura (Bihar), India. He received his degree at Khalsa College, Amritsar, India.

A member working in Kaohsiung on the island

of Formosa, Free China, is Ching-loh Pan. June of 1958 saw his admission to the Society. Pan works as a mechanical engineer at the Taiwan Machinery Mfg. Co., makers of diesel engines, automobile frames and structures, fishing boats, sugar machineries, and high-pressure vessels. After receiving his B.S. degree from the National Pei-Yang University, Pan joined his present firm as a student engineer. He rose to assistant engineer, then superintendent of the forging shop, until finally the firm considered him competent enough to come to this country to study our tooling techniques. While touring the United States, Pan heard of the American Society of Tool Engineers, and liked what he heard. He attended the annual ASTE convention in Philadelphia in 1958. Listening in at the technical sessions and meeting American tool engineers, he became so impressed with the Society and its members that he filled out an application for membership while still in this country. A month before he was to return to his homeland, he was accepted because of his extensive work in tooling and because of his sincere interest in the ASTE. Now he's back in Formosa putting to use the things he learned here and, no doubt, spreading the word of the Society.

Orvis J. Fairbanks, a senior member of Piedmont chapter, is working in Yugoslavia with the American Embassy in Belgrade. A member since 1944, this mechanical engineer is the only ASTE representative in Yugoslavia at this time. He is there in conjunction with the U.S. Operations Mission, a State Department program which offers technical aid to foreign countries.

These are just a few of the men who add to the far-flung reputation of the ASTE. Whatever their names or their places, however, they're all brothers under the skin. The language of the tool engineer is an international language. And the job of tool engineers everywhere is the same—"to plan the processes of manufacture, supply the tools and integrate the facilities required for production of given products with minimum expenditure of time, labor and materials." With all the global character it has been assuming of late, the ASTE might well be called the International Society of Tool Engineers.

Yugoslav Executives Tour U. S. Plants

Nine Yugoslavian tool engineers and designers got a cordial "dobrodoslica" (welcome) from the Adamas Carbide Corp. in Kenilworth, N. J., their second stop in a six-week tour of cutting tool plants in the East and Midwest. Grouped around Adamas President Edward L. Dreyer (below, center) are members, translator and escort of the team, sponsored by the International Cooperation Administration. The lone woman of the group—Nadezda Lazarevic, chief of tool servicing of the Rakovica motor industry—said women were still rare in her branch of engineering, but were well represented in architecture (up to 50 percent) and chemical engineering. At a press conference, the Yugoslavs said there were some Russian machine tools such as horizontal boring mills in use, but that they were "very heavy and bulky" when compared to the prevalent German equipment. Exchange of technical information is predominantly a function of governmental "technical assistants" who gather and pass on information in answer to industry requests, they indicated. There is an Association of Toolmakers but no technical society such as ASTE. The group visited ASTE Headquarters on Sept. 4.

Mayor James P. Hennessy of Joliet, Ill., signs proclamation designating Oct. 31 as "Tool Engineering Day." The proclamation coincides with the 9th annual Illinois Tool Engineering Conference. Watching the signing are, from left, Ray Bachman, conference treasurer; Harold Zierke, secretary; Donald Domnick, executive chairman; and Francis ("Doc") Bowers, general chairman.

Louis Joliet to Host Illinois Conference

JOLIET, ILL.—Francis ("Doc") Bowers, Caterpillar Tractor Co., has been named general chairman for the ninth annual tool engineering conference to be conducted by chapters in Illinois. According to Bowers, this will be the first time in the seven-year history of the Louis Joliet chapter that the event has been held in its city.

Cosponsoring the conference with Chapter 104 will be the Joliet Junior College, site of the technical sessions. Some 400 members and wives from the eight ASTE chapters in the state are expected to attend.

"The theme of this year's conference is 'Tooling for Tomorrow's Products,'" said Bowers. "Technical meetings will present some of America's top speakers in the field of tool engineering. Tours of local industries have been planned, and a banquet on the evening of Saturday, Oct. 31, will climax the conference."

—Gene Senn

ROCKFORD—Northern Illinois and Southern Wisconsin high schools industrial arts students are shown accepting their prizes in the chapter's annual advanced drafting contest. Awards were based on the students' design originality, practicability and drafting technique.

—Ray O. Brown

32-Week Course In Die Design Starts At Williamsport Tech

WILLIAMSPORT—Chapter 49 and the Williamsport Technical Institute will sponsor a 32-week evening course this fall on the design of blanking dies. The technical content of the course was prepared by the Society's National Education Committee. The class will meet once a week for three hours with approximately three hours of outside study required each week.

The methods of teaching this jointly sponsored course will include lectures, films, demonstrations, discussions, and actual practice. The first meetings will be devoted largely to lectures while the later sessions will consist mostly of discussion and practice.

The class is intended to benefit people employed as draftsmen, machinists, apprentices, and toolmakers, who have a knowledge of shop math, basic drafting practice and shop practice. The course is not designed for tool and die designers.

Tuition and registration fees of $9.40 will be payable to the Williamsport School district. Costs of tools, books and supplies will be $55 and payable to ASTE. Fees will be due at the time of registration which is Sept. 28 and 29. The fees will include a personal set of books and tools needed to study and necessary in order to make drawings of blanking dies. It is suggested that, since the work is of a trade development nature, possibly a tuition sharing arrangement could be made between the men taking the course and their employers.

Where an employer contributes a total of $60 to the costs of two or more of his employees, he will receive an affiliate membership in the Williamsport chapter for one year.

Jack Kleinoder, vice president of Vidmar, Inc., of Williamsport, and president of the National Tool and Die Manufacturers Association, will be the main speaker at an advertisers' night planned by Chapter 49 for Oct. 12. The annual program salutes companies that advertise in the chapter bulletin and offers them an opportunity to display their products.

St. Louis Member Dies

ST. LOUIS—Ernest Clark, retired owner of Clark Equipment Co., died recently at the age of 71. He was a charter member of St. Louis chapter and served four years on the constitution and by-laws committee.

—Lyle R. Perry

Arthur Thormahlen, Buffalo-Niagara Chairman, Is Dead

BUFFALO—The 43-year-old chairman of Buffalo-Niagara Frontier chapter, Arthur F. Thormahlen, died of a heart attack Aug. 22. He was president and one of the founders of Niagara Industrial Designers, Inc.

Thormahlen also was second vice president of the recently formed Lake Erie Regional Council of ASTE chapters.

A native of New York, he was educated in Toronto schools. On his arrival in Buffalo in 1947, he formed the tool and machine design firm in partnership with William J. Iekel. In 1953 he purchased his partner's interest and assumed the presidency.

Surviving at the home in suburban Cheektowaga are his wife, Elizabeth, who is vice president of the corporation; two sons and three daughters.

Raymond C. Klas of Hamburg, N.Y., is first vice chairman of Chapter 10.

Arthur F. Thormahlen

Chapters Schedule Campus Conference In North Carolina

RALEIGH, N.C.—"Tooling and Manufacturing Engineering" will be the theme of an on-campus conference scheduled for Nov. 6-7 at North Carolina State College.

New ideas and concepts of manufacturing equipment and processes will be discussed at the technical sessions, directed by the college's School of Engineering in cooperation with the Extension Division. The Piedmont and Raleigh-Durham chapters of ASTE are sponsoring the conference.

In addition to the technical meetings, the conference will feature industrial and educational exhibits and tours.

Springfield, Ohio

Many cost and time-saving processes were discussed at the dinner session of a plant visitation of approximately 60 members and guests of Springfield chapter at the Bulldog Electric Products Co. of Urbana, Ohio, recently. Talks were given by A. R. Calhoun, superintendent of the stamping division, and J. A. Kempf, superintendent of the plastics division. Interesting features for the tool engineers present were the plant's method of electrostrip and the solution of numerous tooling and handling problems.

PHILADELPHIA—Leonard Horoff (left), chairman of Chapter 15, presents Matthew Zubrzycki (second from right) with an award for his scholastic achievement at Spring Garden Institute. Watching the proceedings are Rear Admiral Logan Ramsey (second from left), U.S.N. (Ret.), executive vice president at the Institute, and William E. Chambers, who spoke at the commencement exercises. Five other graduates also received ASTE awards.

SAN GABRIEL VALLEY—Richard Barton, public relations director at North American Aviation, explains a model of the X-15 manned rocket to the son of a member of Chapter 95. The chapter's Father and Son night was highlighted by Barton's talk on the development of the rocket and a film entitled "Mission: Outerspace."

—B. K. Allen

chapter news

Buffalo 141
Hartford 142
Lima 142
Long Beach 142
Lorain 143
Louis Joliet 132, 140
Northern Massachusetts 143
Philadelphia 141
Phoenix 143
Piedmont 141
Raleigh-Durham 141
Rochester 132
Rockford 140
San Fernando 142
San Gabriel 141
Seattle 143
Springfield (Ohio) 141
St. Louis 140
Tucson 143
Williamsport 140

This wing skin stretch press model was part of the display at the Long Beach technical meeting devoted to "Tooling for the DC-8." Shown operating the model manually are (left to right) Jack B. Irby, chapter standards committee chairman; chapter chairman, Irvin Also, and featured speaker Edward W. Hendry.

'Tooling for the DC-8' Described at Long Beach

LONG BEACH—A member of the Long Beach chapter, Edward W. Hendry, spoke to his own chapter members at their August meeting. Hendry's presentation, "Tooling for the DC-8," concerned a subject of great interest, especially to residents in the Long Beach area where the jet transport is being manufactured. Hendry is a projects engineer at Douglas, so he offered a first-hand report on the air plane. The tool engineers of Chapter 84 take pride in hearing of the DC-8 as a finished product, because of their extensive tooling contributions toward it.

The guest speaker covered the complete tooling and production story of the jet. Wing, fuselage and tail assembly jig tool were explained and shown in production with the help of color slides. Assembly handling fixtures, broaching, metal bond, optical tooling and a skin stretch press were also explained in detail. The lecture illustrated many conveniences and colorful interiors incorporated in the latest jet travel.

Several tables of displays were examined by the members. A detailed model of a wing skin stretch press attracted much attention as it was shown in operation. —*Paul J. Bodnar*

LIMA—New members Frank Munday and Bob Keiber were greeted by Membership Chairman Hassel DePree at recent chapter meeting. Chapter 97 also changed its programming at the meeting, in an attempt to achieve more informality and attract more new members. The technical portion of the meeting was held prior to the social hour.

—*Andrew C. Farkas, Jr.*

Hartford Member Dies

HARTFORD, Conn.—Ralph S. Howe, vice president and general manager of the machine tool department of New Britain Machinery Co., has died. Educated at Cornell University, Howe was a member of Hartford ASTE chapter. He was 68.

San Fernando Starts Scholarship Program With Awards to Six

SAN FERNANDO VALLEY—A first in the history of Chapter 99 occurred this August at the monthly meeting. Scholarship awards went to six high school students from the area. To gain experience the San Fernando chapter decided to begin its scholarship presentations on the high school level and eventually work up to the junior and senior colleges. The work of distributing awards will be coordinated with similar efforts of the California Council of Chapters, in order to help provide uniform programs for the area.

Receiving certificates for their scholastic accomplishments were: Bill Darlington, first-place winner; Stanley Robbins, second; Donald Olson, third; John Tongish, fourth; Joseph Dunn, fifth; and Dale Dalton, sixth.

Along with the more than 100 members and guests present, the students listened to a panel discussion concerning "Machining the Impossible," an explanation of three of the newest methods of metal removal. Speaking on electrolytic methods was Harry Whitefield, West Coast engineering representative for Anocut Engineering Co. Sonic techniques were described by Donald Marousek, applications engineer for Sheffield Western Corp. And the president of the Harold L. Stark Co., Harold Stark, elaborated on the spark discharge methods. The three speakers then answered questions put to them by the members and their guests.

—*John R. Bethune*

Robert E. Daly (left), San Fernando education chairman, distributes scholarship award certificates to four of the six winners from local high schools. These are the first such awards to be made by Chapter 99.

TUCSON, Ariz.—Special "Space Age Tooling" committee discusses plans for the seminar to be conducted Nov. 13-14 at the University of Arizona. In the front row (left to right) are Jim Beach, program; Clark Pierce, Tucson chapter chairman and seminar coordinator; Prof. A. G. Foster, university liaison; Steve Cassedy, publicity and advertising; back row, Howard Ackerman, arrangements; Ray Olimski, budget; Cy Jacobson, registration and housing. Chapter 106 has joined forces with the U. of A. Engineering College and the Tucson Chamber of Commerce in planning the seminar on exotic materials and equipment required for the space age.

Position Available

DIE DESIGNER and a DIE FOREMAN experienced in jobbing shop procedures. Write to: Classified Ads, Dept. 153, 10700 Puritan Ave., Detroit 38, Mich.

Positions Wanted

MAINTENANCE SHOP SUPERVISOR —with 30 years' experience in plant and equipment maintenance, strong on fabrication and modification of existing machinery, installation and erection. Some research and development in electronics at machine shop level. 49 years of age, married, U.S. citizen, member of ASTE. Prefer Pacific Northwest location. Write to: Dept. 161, Classified Ads, 10700 Puritan Ave., Detroit 38, Mich.

MANUFACTURER'S REPRESENTATIVE — established manufacturer's agent and registered P.E. seeks additional line in the tool and machine field. Current product in the machine tool accessory field. Area of representation — metropolitan Detroit and Michigan. Write to: Classified Ads, Dept. 158, 10700 Puritan Ave., Detroit 38, Mich.

Vice Chairman Cole, Phoenix Chapter, Dies

PHOENIX, Ariz.—A heart attack was fatal to Walter T. Cole, second vice chairman of Chaper 67, on Aug. 6.

Cole, 51, was owner of the Walter T. Cole Co. of Scottsdale, Ariz., maker of special carbide taps. His widow will continue to operate the business.

A native New Yorker, Cole was active in the Buffalo-Niagara chapter before coming to Arizona four years ago. Besides his wife, survivors include one son.

Lorain Chapter's Treasurer Drowns

LORAIN, Ohio—William Weslow, treasurer of Lorain County ASTE chapter, drowned Aug. 10 when he fell from his boat while on a fishing excursion with his son and daughter. He was 40.

Born in Cleveland, Weslow had lived in Elyria since 1945. He was a sales engineer for the Butterfield Div. of the Union Twist Drill Co. and formerly was president of the Diamond Products Co. of Elyria. A civic leader, he was past president of the Elyria Youth Council's adult advisory board and a member of the present board. He joined ASTE in 1956, and was also a member of the Cleveland Engineering Society. Besides the children with him at the time of his death, he is survived by his wife and another young son.

SEATTLE—Walter F. Hiltner (left), lunar systems manager at Boeing Airplane Co., describes model of a typical rocket to L. Van Auken, program chairman, and Gordon Duncan, chairman. Of special interest to tool engineers, Dr. Hiltner said, is the fact that most of the space stations and many of the vehicles will have to be assembled in outer space.

—Ralph F. Ingebretsen

Short Run Stamping Advantages Are Cited

NORTHERN MASSACHUSETTS—A leader in the "short-run" stamping industry, John J. Head, spoke at Chapter 100's meeting. Head, who is sales manager of the Duplicon Co. in Westboro, Mass., entitled his presentation "Designing Short-Run Stampings." He spoke to the 60 present on the economic advantages of metal stamping in small lots and how the correct selection of material, tolerances and basic functional design can effect cost savings. By means of illustrations and a number of samples, he demonstrated the value of this method to small and medium-sized manufacturers.

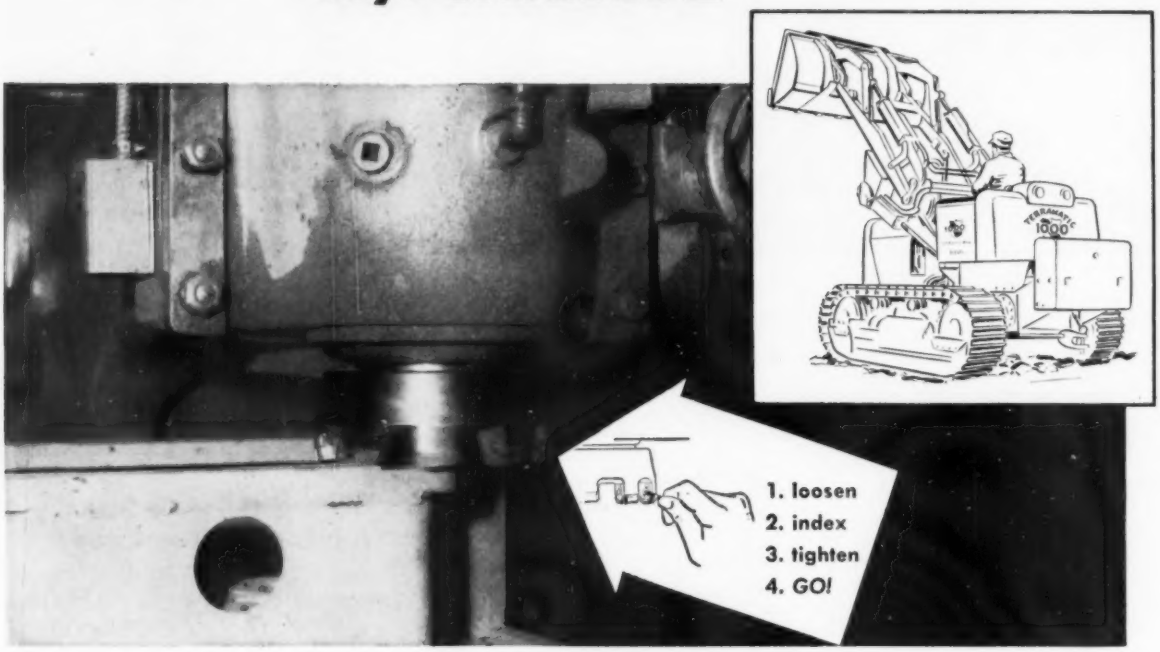
Prior to Head's association with Duplicon, he designed and manufactured industrial material handling equipment. During World War II he was responsible for the maintenance and overhauling of bomb sights in the Southwest Pacific theater.

—Richard I. Edwards

SPECIAL EVENTS

Hartford Night—"What Educators Can Do for Industry," by Dr. Albert Waugh, Vice President, Univ. of Conn.	Oct. 5	Hartford, Conn.
ASTE Semiannual Meeting	Oct. 8-10	The Chase-Park Plaza Hotels, St. Louis, Mo.
ASTE Seminar—"Numerical Control in Creative Manufacturing"	Nov. 17-18	Sheraton Hotel, Philadelphia, Pa.
ASTE 28th Annual Meeting	April 21-28, 1960	Statler Hilton and Sheraton Cadillac Hotels, Detroit

Milling Cutters are dependable says J.I.CASE



16 months of continuous milling on TERRAMATIC transmission housings

It's no "pink tea party" when you chew a quarter-inch of rough 1015 Weldment Steel casting — spinning the milling cutter at 800 s.f.p.m. That milling cutter's got to be tough — *plenty tough* — and the carbide inserts need real "backbone."

J. I. Case found the right combination in V-R Face Mill Cutters with V-R throw-away carbide inserts. Big demand for Case Terratrac dozers, diggers, and crawlers, with Terramatic Transmission, has kept production lines humming — 2 and 3 shifts a day — 16 months continuous production. In this picture there's no place for excessive downtime, or delays for tool regrinding. V-R Face Mill Cutters provide cutting edges right on the job — a turn of a wrench — index the insert to a new cutting edge — tighten — and away you go! (Minimum maintenance problems, too: in *16 months production only 3 sets of main screws and 1 chip breaker plate needed replacing.*)

Your V-R representative has the facts on Face Mill Cutters and all carbide cutting tools — call him in today or send for Catalog VR-58.

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TURNING AND BORING NUMERICALLY CONTROLLED

Numerically controlled, the double spindle turning and boring machine illustrated will precision machine inside and outside contours of hemispheres, cylinders, and other related metal parts with infinite variations from a hemispherical contour to a repeatability of 0.0001 inch.

Adapting numerical control to this single point, two-axis machine makes possible machining to a tolerance of ± 0.0001 inch. In many instances, tolerances of ± 0.000070 inch are achieved to maintain critical inside and outside diameters. The numerical control system provides a command pulse value to each of the two machine slides of 0.000025 in. or 40,000 pulses per inch of slide travel.

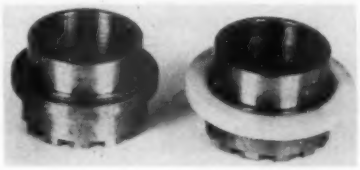
In operation, one spindle of the machine tool is used to machine the outside diameter and the other spindle is used to machine the inside diameter of the part. Only one spindle at a time is operated on this machine.

The workpiece is clamped in a rotating fixture attached to the spindle. A single-point tool, which is mounted on two hydraulically operated slides, is numerically controlled in two axes (longitudinal and transverse) to machine the desired part shape to extremely close tolerances.

Heald Bore-Matic turning and boring machine is equipped with Bendix numerical control system. It produces hemispheres, cylinders, free-formed turned shapes to close tolerances.

NYLON MACHINE PARTS HAVE GOOD LIFE

Machine tool designers are rapidly gaining confidence in industrial or engineering plastics, and increasing the use of plastics to improve machine operation, cut noise level, reduce lubrication and increase machine life. Used properly, the industrial plastic parts reduce total costs, although original material prices may be higher than the metal parts they replace.



Only a slight design modification was required to change from the ball bearing to the solid nylon collar. Cost of the collar is about one-third as much as the ball bearing and provides longer service life.

An example of lowered cost and improved operation is the use of nylon in a universal milling machine. Three major parts, the clutch gear collar and both cross feed and table feed leadscrew nuts, are machined from extruded nylon bar stock produced by The Polymer Corp.

The first application tested was the clutch gear collar for back gear engagement. Previously, a three-inch OD ball bearing was used as a collar. The nylon collars are machined from 3-in. OD x 2-in. ID Polypenco tubular bar at a cost of approximately one-third that of the ball bearings. The major source of wear on the 9/32 in. wide nylon collar is during engagement. Either engaged or disengaged, there is little load on the collar.

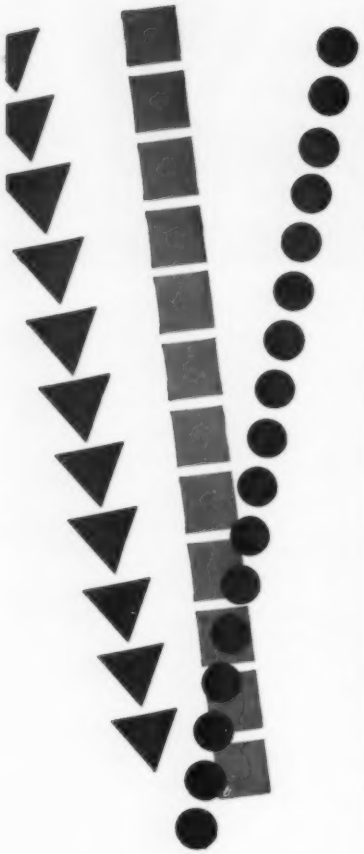
The use of nylon for leadscrew nuts is far more critical. Accuracy of any horizontal setting depends on removing the backlash from the longitudinal and cross feed. Most of the wear and resulting end play is concentrated in the leadscrew nuts. Nylon 101 leadscrew nuts reduce wear and backlash to one-third that of bronze leadscrews.

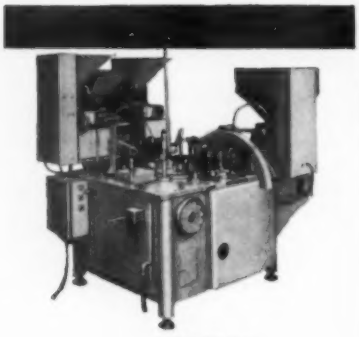
The 1-in. 5-pitch Acme thread is cut from $1\frac{1}{4}$-in. OD x $\frac{3}{4}$-in. ID nylon tubular bars. Two lengths are installed perpendicular to each other in the same casting. Being mounted under the table, leadscrew nuts are in one of the most difficult locations to lubricate. The new design alleviates this problem as the nylon nuts require no lubrication for either hand or power-feed milling machines. These successful applications should lead to a host of others in the machine tool field.

HAND-FED SORTER DOUBLE CHECKS DRILLS

A sorting of 6500 jobber-size drills an hour is accomplished on an inspection machine developed by Chance Vought Aircraft's manufacturing engineering department. The machine can handle 52 different sizes of drills ranging from 3/32 to 17/64 in. in size. Gaging surfaces are fixed, giving high accuracy in dropping the drills in the correct metal tray below.

With this drill sorting machine, smallest drills are sorted in the righthand bank, graduating to the largest sizes in the near bank.





NEW V & O MACHINE

for small parts assembly

offers a basic operating principle almost endless in its applicability to cost reduction.

Emhart Manufacturing Co.
Hudson, New York
V & O Presses and Feeds

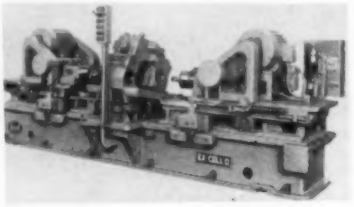
USE READER SERVICE CARD, CIRCLE 58

Four banks of sorting racks are mounted on a portable table. Drills are fed by hand at the top of each sloping bank. A semicircular "flipper," the only moving part, moves them from one sizing station to the next until they drop through the correct slot. Each drill is checked twice by the machine before dropping through.

Small electric motors on the four banks provide power to move the flippers 53 cycles a minute. Use of the drill sorter enables speeding up of the sorting process, gives a more accurate check for small-sized drills, and results in fewer rejects since the drills are sharpened by the crushed-wheel method of grinding. Burred drills present no particular problem since the machine has slip clutches which stop the whole bank if a slot is jammed.

SPECIAL MACHINE BORES AND FACES

Recently introduced is an Ex-Cell-O machine which performs heavy rough boring and plunge facing plus precision finish boring and facing in one machine cycle. Parts are large cast-iron rollers, components of track assemblies for heavy-duty crawler tractors, manufactured by the Caterpillar Tractor Co. The machine was specifically designed for Caterpillar.



Special machine for rough finish boring track rollers for crawler tractors.

In operation, the part is loaded in the hydraulically operated fixture and indexed to the rear of the machine. Here the part becomes aligned with the rough boring spindles and roughing operations are performed on both ends of the part simultaneously. At the end of the stroke, both slides retract and the fixture indexes toward the front, ready for finish machining. Both slides again advance automatically and finish boring and facing are performed, again simultaneously on both sides of the part. After the finishing stroke, the slides retract and the fixture is unclamped ready for the next cycle.

Each spindle is individually driven from the double extended shafts provided on the drive motors, enabling a comprehensive range of operating speed. Torque at the relatively low speeds is obtained by driving each spindle through a cone drive reduction unit.

Versatility is achieved by readily changeable tooling heads and clamping jaws, minimizing change-over time and making possible the production of any one of three similar components.

EXPERIMENTAL PRODUCTION PLANNED FOR INFLATABLE METAL TUBING

Experimental production of lightweight seamless metal tubing that can be shipped in ribbon form and inflated at the point of use will be begun this fall by the Wolverine Tube Div. of Calumet and Hecla, Inc.

The new material, to be known as "Strubing" (strip tubing), may be of use in such industries as construction, electric power distribution, communications, rockets and missiles, farming, packaging, chemical and general manufacturing.

It is expected that the methods and equipment to be used for inflating Strubing will vary with the application

Strubing production sequence illustrated (top to bottom) involved flattening of 3-in. diam base tube, additional passes through rolling mill to obtain thinner wall, and inflation to produce tube represented by section at the bottom of illustration.

of the material and its dimensions. Company engineers have used hydraulic pressure, air pressure and mechanical means of inflation. In some cases, tap water pressure was sufficient.

The material can be made in sizes ranging from smaller than the lead of a pencil to a pipe large enough for a

man to walk through. It can be made as thin-walled as household metal foil and as thick-walled as conventional pipe. It will be possible to ship the material in coil lengths of as much as 15,000 feet.

The company reports that techniques involved in the manufacture of the tubing are basically simple. A hollow shape, made by conventional methods, is passed through a rolling mill where it is flattened into ribbon form. The rolling process elongates the original tube, making it thinner without changing the inside tube diameter. The more passes through the rolls, the thinner the tubing. Diameter of the tubing is limited only by the size of the starting piece, and size of the starting piece is limited only by the capacity of the rolling mill used.

Inherent in the product produced by the rolling process are fins or ribs on the outside which provide added stiffness to the tube or which can be removed as the tubing is formed.

PROCESS PROVIDES PRECISION CASTING

A precision process for producing small parts in large volumes combines the inherent features of investment casting with other precision forming techniques such as shearing, sizing and coining. Since it was introduced by Casting Engineers Div., Consolidated Foundries and Mfg. Corp., the process has turned out volume quantities of parts for electronic, metalworking, firearms, machinery, and other varied industries.

Requirements for Minicast parts are sizes less than one cubic inch and production volumes of at least 25,000 parts. Principal features of the process are exceptional tolerances, as low as —0.001 in., superior surface finish, complex configurations and wide selection of alloys.

The area of alloy selection is an important feature of the process. Foundry characteristics are of primary importance. A specified alloy should have a high degree of fluidity to insure proper flow in thin sections, and to prevent "shorts" or incomplete fill. Generally, these alloys yield castings with a good surface finish, an important factor where close tolerances are involved.

The alloy should be relatively brittle in the as-cast condition to facilitate the removal of gates, since the tiny size of Minicast parts often precludes conventional gate grinding techniques. Most high carbon steels, stainless steels, cobalt-chrome alloys, and copper base alloys can be specified for the Minicast process. Lead, tin, zinc, cannot.

...with Miller Phosphor Bronze

A manufacturer of electrical controls was plagued by two problems in the production of this refrigeration control bellows component: Rejects of the part were excessively high—as much as 45%—and chemical action of the refrigerant created a corrosive film which impaired accuracy of operation. The company's own metallurgists specified a phosphor bronze alloy to meet these problems. But only Miller had the special skills necessary to actually produce this tailor-made metal. Now, phosphor bronze by Miller has reduced rejects to the absolute manufacturing minimum—and effectively resists chemical action. Miller specializes in tailor-made phosphor bronze alloys . . . to solve your toughest production problems. At Miller, Phosphor Bronze is the main line not a side line.

miller SINCE 1944

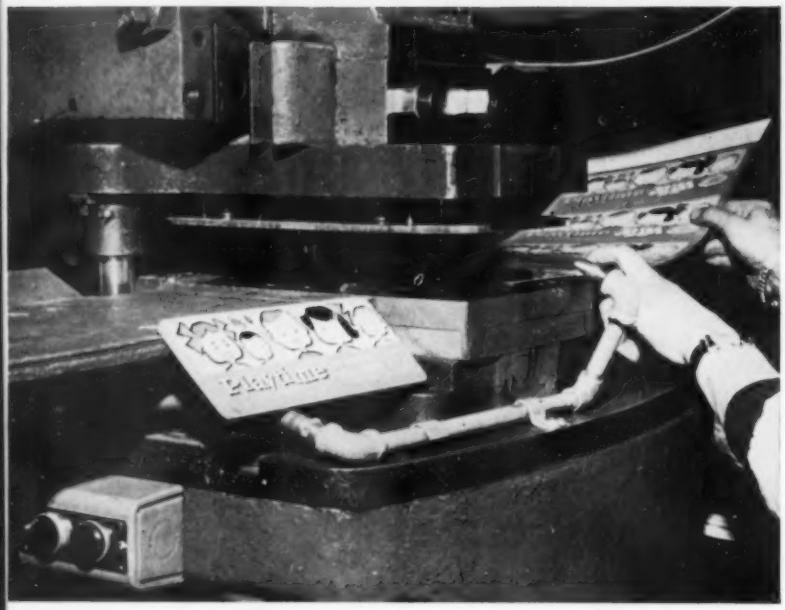
ROLLING MILL DIVISION
THE MILLER COMPANY
MERIDEN, CONN

. . . WHERE PHOSPHOR BRONZE IS THE MAIN LINE—NOT A SIDELINE
USE READER SERVICE CARD, CIRCLE 59

Tool Steel Topics

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.



Lehigh H Teams Up with Brake Die

Result: 150,000 Box Tops

The job was a tricky one. It called for the blanking and forming of .010-in. black plate into hinged tops for children's paint boxes. But with the black plate already lithographed, it was imperative to avoid marring the material.

The manufacturer, Sobel Metal Products Co., Easton, Pa., talked it over with his local Bethlehem tool steel distributor, Luria Steel Supply Co., Catasauqua, Pa. The Luria representative proposed the use of Lehigh H for the die, and Brake Die for the punch. This proved a wise choice, for combined, the two tool steel grades turned out 150,000 pieces without any need for redressing. And the black plate received nary a scratch.

Bethlehem Lehigh H (AISI D-2) is our easy machining high-carbon, high-chrome tool steel. It is an air-hardening grade, with plenty of wear-resistance thanks to its excellent carbide distribution. Brake Die, a grade of special analysis steel, is oil quenched and tempered to develop the mechanical properties needed for maximum wear and toughness.

Bethlehem regularly produces about 30 different grades of tool steel—a range so wide as to meet virtually every requirement. For full information, call your Bethlehem tool steel distributor.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Hot-Work Tools Last Longer When Thermal Stress Is Reduced

Deterioration of hot-work tools in service by heat checking or cracking depends largely on the severity of thermal stress developed in service. Anything which can be done to decrease the magnitude of the thermal stress will increase the service life of the tools.

One of the most essential steps in using hot-work tools is to preheat them to their normal working temperature before use. This seemingly insignificant step will often improve the tool life appreciably because it decreases the severity of the initial stress cycles.

The provision of multiple tools which are used in succession is another simple way to decrease thermal stresses on certain types of hot-work tools. For example, on piercing operations the press may be provided with as many as six piercing punches mounted on an indexing fixture. After each piercing operation a different punch is moved into position for the next operation. This permits each punch to cool during the time of the next five operations, greatly reducing the severity of thermal stress. The service life of punches used in this manner is often twice that of punches used continuously in the same operation.

Air-4 hardens in air at 1550F.

With AIR-4 You Get Air-Hardening at Low Temperatures . . . FREE MACHINING . . . EXCELLENT WEAR

Air-4, Bethlehem's new medium-alloy tool steel, hardens in air at 1550F, and has excellent free-machining properties due to its carefully controlled addition of lead. It has exceptional wear-resistance and high toughness. Moreover, it can be heat-treated with complete freedom from the dangers of cracking. Ask your Bethlehem tool steel distributor for complete information on Air-4.

TOOLS of today

Rotary Index Table

Model 710-V power rotary table is designed for surface grinding. It can also be used as a hand-operated index table for drilling or grinding equally

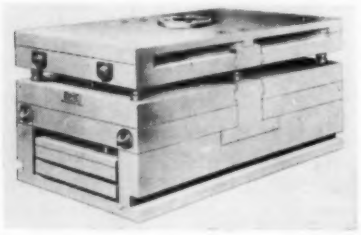
spaced holes. Index accuracy on a 10-in. circle is held to 0.0003 in. on 24 sections.

M & M Tool & Mfg. Co., 1124 E. Third St., Dayton 2, Ohio. **Circle 350**

Unit Die Assemblies

Unit die construction enables the plastic injection molder to replace cavities in a matter of minutes, a useful feature where a variety of products are being made from the same type of plastic.

Three sides of the die are open for installation of cores or coolant lines.



The twin replacement units are standard 9⅞ by 8 in. Tubular dowel construction eliminates interference with placement of water lines.

The dieholder includes a sprue brushing, locating ring, leader pins, return pins and a master ejector plate. A set of matched replacement units is delivered with pins and plates installed.

Detroit Mold Engineering Co., 6686 E. McNichols Rd., Detroit 12, Mich. **Circle 351**

USE READER SERVICE CARD ON PAGE 173 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Carbide Applicator

Wear resistance of drills, taps, single-point turning tools, press tools, stress sections of large dies, planer blades, end mills and other tools can be increased with carbide. This impregnator unit applies either a coarse or fine layer of carbide to the cutting surface of high-speed tools.

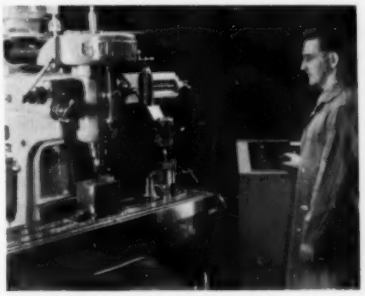
Localized sparking action causes carbide to penetrate the metal of the tool, building up a layer of approximately 0.003 in. with a coarse setting and approximately 0.0005 in. on a fine setting.

The OK Tool Co., Inc., Milford, N. H. **Circle 352**

Electrohydraulic Tracer

Equipped with a 360-deg tracer, this vertical mill is shown automatically profiling a printing press shifter fork. A deflection meter furnishes direct readings of tracer deflection. Since the tracer does not depend upon magnetism or electrical conductivity to hold it in contact with the master, a variety of master materials may be used.

No drive mechanism is required to rotate the stylus, making slow feed rates practical. Tracing and cutting are automatic and the machine eliminates and



rejects scrap. The profiler can be furnished with automatic vertical increment feed. Over-all size of the machine, without control console, tank and pump units, is 80⅜ in. high, 95¼ in. wide and 80½ in. deep. Weight is approximately 3700 lb.

The company also manufactures a 180-deg duplicator.

George Gorton Machine Co., 1321 Racine St., Racine, Wis. **Circle 353**

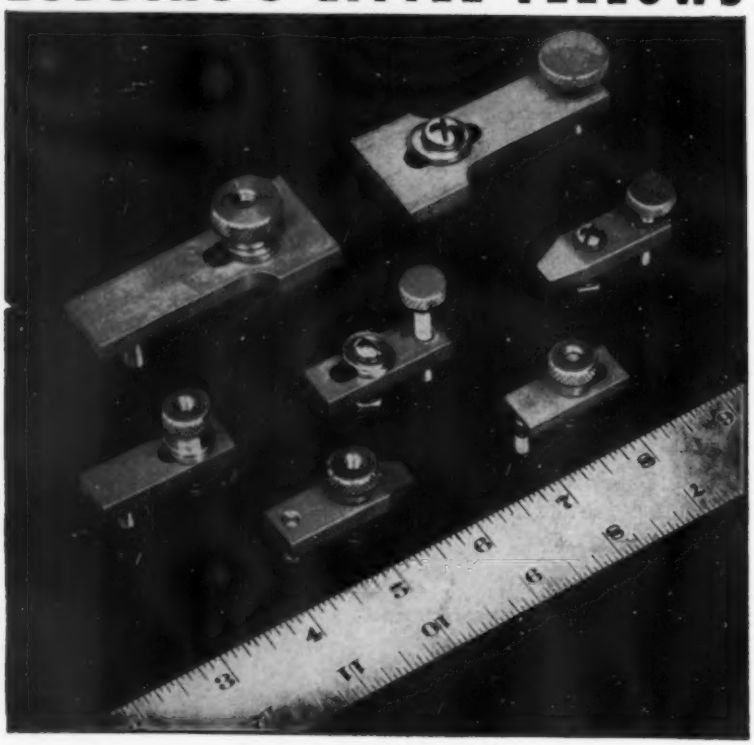
Gear Reducers

Double and triple-reduction gear reducers have mounting facilities for separate motors of suitable horsepower and speed. Spline drive pinion permits quick ratio changes without complicated disassembly. Double-reduction units have a range of 1 through 125 hp, with reductions from 230 to 45 rpm. Triple-reduction units range from 1 to

50 hp, with reductions from 37 to 7½ rpm.

The Lima Electric Motor Co., Inc., Dept. 381, Lima, Ohio. **Circle 354**

LODDING'S LITTLE FELLOWS



- **Non-magnetic - Stainless steel type 303**
- **Tensile strength 90,000 p.s.i.**
- **Heat resistant - austenitic series (not affected by heat treatment with high resistance to scaling and distortion)**
- **Corrosion resistant (high resistance to many corrosives including acids)**

More than 85 details and 30 assemblies available immediately from stock

LODDING, INC.
AUBURN, MASSACHUSETTS

Goodwin-Snader Co.
6814 S. Western Ave.
Los Angeles 47, Calif.
PLeasant 3-1553

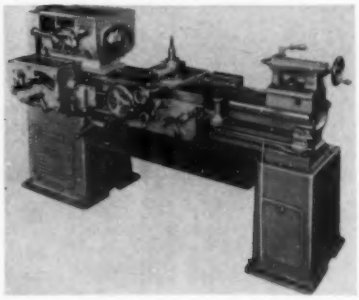
Southern Tool Dist. Co.
54 11th St. N.E.
Atlanta 9, Ga.
TRinity 5-7065

Bagby Engineering Co.
1047 Forest Ave.
Evanston, Ill.
AMbassador 2-2273

USE READER SERVICE CARD, CIRCLE 61

Engine Lathe

Model GH 16-in. geared head engine lathe is available in three lengths. Twelve spindle speeds range from 20 to 900 rpm. Spindle types are LO taper or threaded nose. Friction type clutch



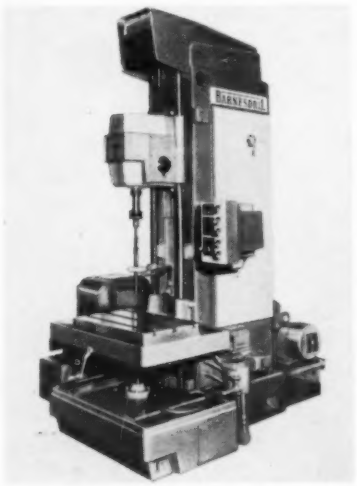
and brake provide spindle control. Gearbox is furnished with 48 separate threads and feeds. Gearbox levers make 3 to 184 tpi available.

Carroll-Jamieson Machine Tool Co., Dept. 5, Batavia, Ohio. **Circle 355**

USE READER SERVICE CARD ON PAGE 173 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Honing Machine

Model 244 is designed to hone bores ranging from ½ to 6 in. in diameter. Sizing unit maintains consistency within 0.0002 in. from bore to bore. An electric hone expanison unit gives feed adjust-



ment without tubes and rectifiers required in electronic controls. Rapid expansion, rapid collapse and automatic

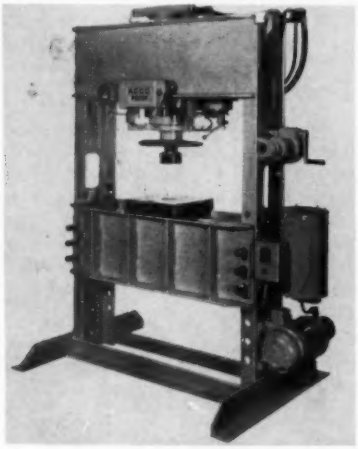
compensation for stone wear are electrically controlled.

The machine is available with one or two spindles in a choice of three stroke lengths. Floor space required is 40 x 86 in.

Barnes Drill Co., 870 Chestnut St., Rockford, Ill. **Circle 356**

Hydraulic Press

Model MPH-150-E22 150 ton electric-hydraulic press has a 2-hp motor, ram speed at no load of 4.2 ipm and 2 ipm at full load. Model MPH-150-E55 has a 5-hp motor, ram speed at no load of 11 ipm and 7.5 ipm at full load. Operating characteristics are: ram travel, 8 in.; screw travel, 8 in.; table travel, 24 in.; horizontal head travel, 19⅜ in. Press



dimensions are: maximum ram-to-table distance, 29½ in.; over-all height, 91¼ in.; 48 in. width between uprights; 12¼ in. width between table channels; and, in both units, floor space requirements of 45 x 73 in. Respective shipping weights are 3000 lb and 3200 lb.

American Chain & Cable Co., Inc., 929 Connecticut Ave., Bridgeport 2, Conn. **Circle 357**

USE READER SERVICE CARD ON PAGE 173 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Heavy-Duty Lathes

Major modifications on series 2013 Clearing-Axelson lathes include greater motor horsepower, increased spindle speeds and enclosure of the gearbox. The lathe has hardened and ground headstock gears, bedways and cross feedscrews.

Micrometer cross feed threading stop

GAS • OIL • ELECTRIC • DIRECT FIRED OR ATMOSPHERE CONTROLLED

Production Heat Treating Equipment

of any of these types

○ BATCH ○ CONVEYOR ○ ROTARY
○ CAR TYPE ○ SHAKER HEARTH
○ ROLLER TYPE ○ WALKING BEAM

Working With These Materials:
Aluminum • Brass • Cast Iron • Copper
Malleable • Stainless • Steel

For Any of These Processes:
Annealing • Brazing • Carburizing • Carbo-Nitriding
Carbon-Restoration • Forging • Hardening
Normallizing • Sintering • Tempering

HOLCROFT & COMPANY

6545 EPWORTH BLVD. DETROIT 10, MICHIGAN TYLER 4-5700

43 YEARS OF ENGINEERING LEADERSHIP

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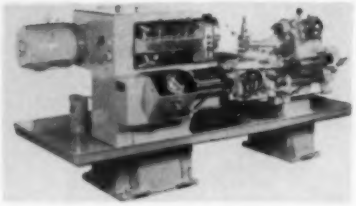


controls diameters for step shafts and in threading to 0.0005 in. Swing over the bed is 22½ in. Swing over the carriage is 13¾ in.

M.T.D., Clearing Div. of U.S. Industries, 6499 W. 65th St., Chicago 38, Ill. **Circle 358**

Grinding Wheel

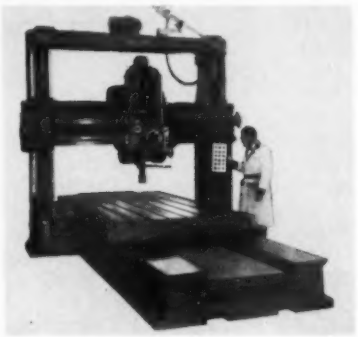
Flexible grinding wheel for cleaning and polishing metal parts utilizes abrasive cloth leaves cut into thin strips. The strips mold to irregular shapes and reach areas normally requiring hand finishing. Wheels are 14

and 16-in. diam. Widths from 3 to 60 in. are available. Grits range from No. 50 to N. 320 aluminum-oxide cloth.

Merit Products, Inc., 3691 Lenawee Ave., Los Angeles 16, Calif. **Circle 359**

Drilling Machine

An automatic positioning table 72 by 126 in. is a feature of this automatic planer type drilling machine. Workpieces can be located for drilling, reaming, boring, tapping and milling by pin bar spacing, vernier and rules, or by tape or manual numerical control which permits positioning the table with accuracy of ±0.0002 in.



An a-c 20-hp motor powers the drilling head which has 36 spindle speeds and 18 feeds. Table movement is 120 in. Table traverse rate is 140 ipm with the head traversing at the rate of 100 ipm.

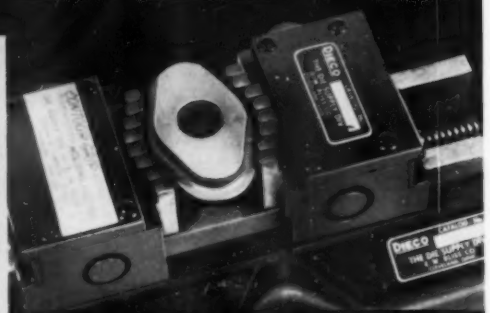
The Carlton Machine Tool Co., 2961 Meeker St., Cincinnati 25, Ohio. **Circle 360**

Hydraulic Lift Table

A die pull-off and pull-on winch is incorporated in this dual-purpose table for die handling and sheet feeding operations. The 20,000-lb capacity table

CONTOUR GRIP

on a lathe... Contour Grip works with any two, three or four jaw chuck, wrench or air operated.



SET UP ANY JOB IN SECONDS
then take deeper cuts, faster feeds

on a milling machine ... Contour Grip makes high speed milling of tough-to-hold parts easy.

on a grinder... this multiple set-up on a Blanchard helped a manufacturer increase his output ten-fold!

Any tool becomes more productive when you use Bliss' new Contour Grip holding fixture; any operator becomes faster.

Contour Grip is a standard fixture that will hold any irregularly shaped part so tightly that you can feed faster and take deeper cuts. It can be used with *any* type of tool, eliminating the need for costly special-purpose jigs and fixtures. And, as picture above shows, your operator can set-up Contour Grip in seconds, then go from piece to piece just by backing off the jaws, dropping the next piece in and tightening up. For long runs or short, it's as simple and as quick as that.

The key to this all-purpose holding fixture's versatility is its individual steel fingers, each of which moves independently as it contacts the work. The fingers mold around the part, and then tighten up *giving greater holding power and a more positive grip than any ordinary fixture can.*

To learn how Contour Grip works and to see the various models available, see your local dealer or contact us direct.

SEND FOR BULLETIN

dieco DIE SETS

E. W. BLISS COMPANY
DIE SUPPLY DIVISION
1400 Brookpark Road
Cleveland, Ohio

Available in Canada through John Bertram & Sons, Ltd. Dundas, Ontario
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is portable and has a tractor hitch for proper positioning at presses. Floor locks are provided and a foot switch controls vertical movement of the table top.

West Bend Equipment Corp., West Bend, Wis. **Circle 361**

Etch-Resistant Coating

Suited for use on steel, aluminum, titanium, nickel, magnesium and other metals, a light-sensitive plastic coating material is available for use in chemically milling a wide range of metals. It resists all commonly used acids, alkalis and electrolytes.

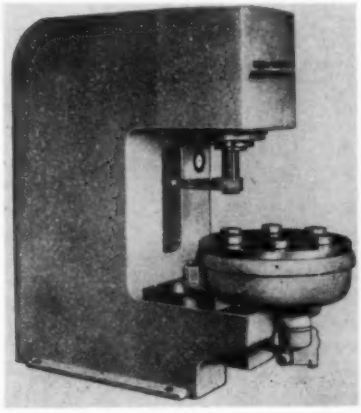
Metal-Etch Resist works by sensitivity to light. After surface application of the plastic, the piece is exposed to high-intensity light from carbon arc or mercury vapor lamps. After treatment, the light-exposed areas resist action of etching solutions.

Eastman Kodak Co., Rochester 4, N. Y. **Circle 362**

USE READER SERVICE CARD ON PAGE 173 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

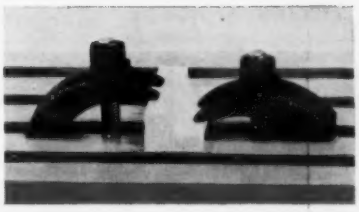
Hydraulic Bench Presses

Series T hydraulic Multipresses, in capacities from 4 to 12 ton, are self-contained bench units with rigid frames, large bed area and increased knee room. An easily accessible relief valve provides quick adjustment of ram pressure. The presses have quick-adjusting inch and stroke change controls. Manual or automatic controls are available.



Over-all height is 52½ in. without the bench. Weight is approximately 1800 lb.

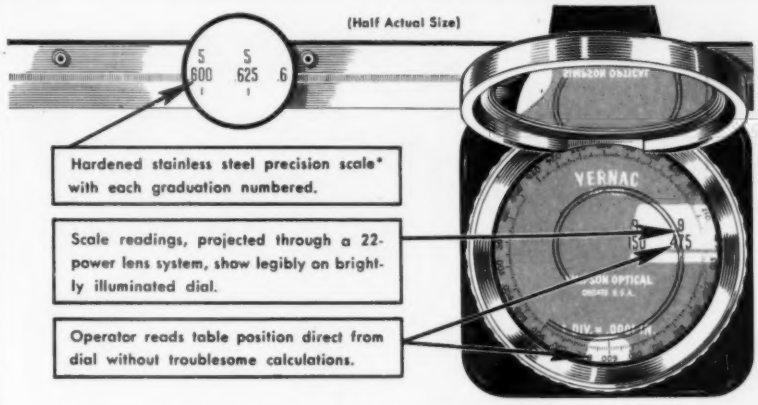
Denison Engineering Div., American Brake Shoe Co., 1160 Dublin Rd., Columbus 16, Ohio. **Circle 363**



Hold-Down Clamp

These heavy-duty steel hold-down clamps eliminate shine; can be applied to fixtures and jigs, used on universal and vertical mills, jig borers, punch presses, planers and drill presses; and will lock any workpiece in position.

Insta-Clamp Co., 2420 Home Place, Dearborn 8, Mich. **Circle 364**


(Half Actual Size)
Hardened stainless steel precision scale* with each graduation numbered.
Scale readings, projected through a 22-power lens system, show legibly on brightly illuminated dial.
Operator reads table position direct from dial without troublesome calculations.
VERNAC

New optical measuring instrument assures . . .

high operating accuracy for new or used machine tools

The new VERNAC Direct Reading Optical Measuring Instrument eliminates the complexities of using end rods and gage blocks. Now, the longitudinal, lateral or vertical positioning of machine tool tables can be quickly and easily read direct to .0001". Accuracy is not affected by the wear or stretch of table movement screws. The instrument itself has no moving parts which can impair accuracy.

VERNAC instruments also up-grade machine tools to perform tasks beyond their original accuracy. For example, they can up-grade moderately priced milling machines to the accuracy of more expensive jig boring machines at a fraction of the latter's cost.

*The scale is a replica of a master certified by the U.S. National Bureau of Standards to .0001" maximum error over its entire length.

SEND FOR FREE BULLETIN. Explains how the VERNAC enables you to do more precise work on your present machine tools.

VERNAC® UNITED STATES AND FOREIGN PATENTS PENDING

Designed and Manufactured by
SIMPSON OPTICAL MANUFACTURING CO.
3202-04 Carroll Ave., Chicago 24, Ill.

Manufacturers and designers of precision optics for scientific equipment since 1926.

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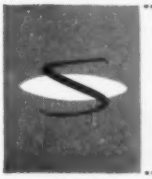

Simpson Optical Manufacturing Company, 3202-04 Carroll Ave., Chicago 24

Send me free literature describing the VERNAC Optical Measuring Instrument.

Name

Company

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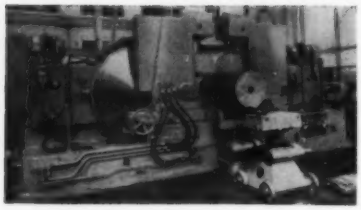
Cold Sawing Machine



Model WKD 1600 cuts large rounds, squares and slabs of alloy steels with saw blades of 63 or 71 in. diam at any one of 12 speed ranges. Two standard saw carriages have blades opposing each other in the same plane and cut simultaneously from both sides of the stock. As the center of the cut is approached, one blade is retracted in rapid reverse while the other completes the cut. A positive automatic shifting arrangement prevents accidental contact of the blades.

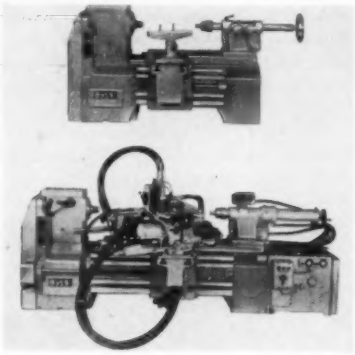
The infeed roller has a lifting capacity of 12½ ton. Two independent hydraulic systems provide variable feed ranges from 0 to 16 ipm.

Albert Klingelhofer Machine Tool Corp., 740 Colfax Ave., Kenilworth, N. J. **Circle 365**

Flow Forming Lathes

Flow forming and spinning lathes to meet a wide range of production needs are available in the D-35 series. The heavy-duty, hydraulic, semiautomatic copying machine will mass-produce cylindrical and tapered parts.

Operating spindle speeds, at constant output, are 45 to 1200 rpm, steplessly



adjustable through a hydraulic drive. Start, stop and speed selections are remote controlled. Patented slideways and gib design, with two carrying surfaces perpendicular to each other, assure positive guidance despite forming pressures. The lathes will flow-form aluminum up to ⅜ in. and steel up to ¼ in. thick. Cross slide travel is 6 in., center distance, 42 in. and main motor drive is 7.5 hp.

Cosa Corp., 405 Lexington Ave., New York 17, N. Y. **Circle 366**

USE READER SERVICE CARD ON PAGE 173 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Air Line Filter

This Micropleat filter which removes dirt, water and oil from factory air lines has been developed for precision air gage applications where positive removal of these elements is a basic requirement for proper gage functioning.

The assembly consists of an aluminum filter head that houses the inlet and outlet ports, a chemically coated aluminum bowl with a drain cock and

Buck
chuck
teamed up *right*
really pays off

Landis Universal at Angelus Sanitary Can Machine Co., Los Angeles, California

Take a *good* machine . . . complement it with a Buck chuck . . . and *you make money every time!*

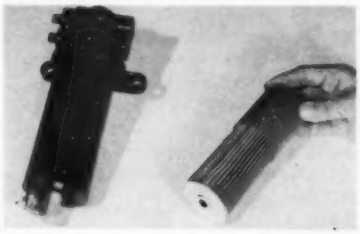
The job above was grinding O.D. and I.D. of tool steel bushings. The flexibility of the machine plus the precision of the Buck cuts grinding time in half! Tolerance of ± .0005" was no problem for the buck.

Make any comparison you want . . . there is no other chuck with the quick, adjustable, precision capabilities of Buck Ajust-Tru® chucks. Send for a catalog—see why "It pays to chuck with Buck."

Makers of Scroll, Power, Dust Proof, Independent Chucks.

BUCK TOOL COMPANY
1033 SCHIPPERS LANE • KALAMAZOO, MICH.

USE READER SERVICE CARD, CIRCLE 65



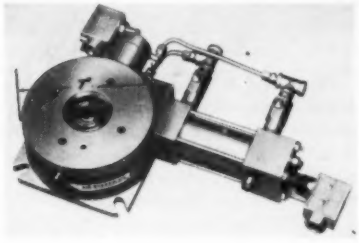
a Micropleat filter element. The filter housing will withstand line pressures up to 125 psi. Rated flow for the assembly is 15 cfm at 100-psi line pressure.

The filter element is a pleated, phenolic resin impregnated cellulose cylinder with a deflector baffle around the top. The No. 571000 air line filter measures 9⅞ in. in over-all length.

Bendix Filter Div., 434 W. 12 Mile Rd., Madison Heights, Mich. **Circle 367**

Index Table

Model 700 7-in. will make up to 75 indexes per minute and will handle a maximum work load of 100 lb. Maximum power stroke is three times line pressure. Four, six, eight or twelve



stations are standard.

Air Hydraulics, Inc., 675 Hupp Ave., Jackson, Mich. **Circle 368**

Bending Machine

Precision hydraulic benders will handle tubing of 1½, 3, 6 or 8 in. diam. The machines will bend repeatedly to ±¼ deg accuracy in 180 deg with radii as small as one diameter. The

To get the most out of barrel finishing

ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE • OVER 250 SERVICE MEN • OVER 160 MATERIALS

Barrel finishing cuts unit-cost of deburring from 15¢ to 1¢! How much could it save you?

In one midwest plant, total cost of deburring 20,000 complex aircraft parts by barrel method came to less than $200. This compares with a former cost of $3,000 by hand methods.

This startling reduction in cost is the result of handling hundreds of pieces at a time, instead of grinding each one separately . . . and the result, too, of using the right compound to help the media and barrel do their work.

It's in selecting and supplying the right compound that Oakite helps you get the most out of barrel finishing. Oakite compounds include alkaline and acidic types . . . for steel, brass, zinc die castings, aluminum or alloy parts.

Ask your local Oakite man about barrel finishing, or write for free booklet on barrel finishing to Oakite Products, Inc., 28A Rector Street, New York 6, N. Y.

it PAYS to ask Oakite

OAKITE

50 1909-1959 SCIENCE

years' leadership in industrial cleaning

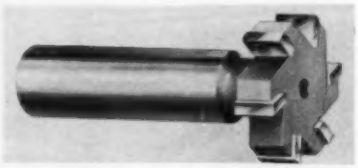
USE READER SERVICE CARD, CIRCLE 66

hydraulic mandrel loading-extracting cylinder has a 48 in. maximum adjustable stroke. Run-out does not exceed 0.0015 in. tir in 180 deg rotation. Slides of both stationary and swinging arms are held parallel with the die boss within 0.015 in. tir at any point up to the maximum radius of each machine size.

Pines Engineering Co., Inc., 601 Walnut St., Aurora, Ill. **Circle 369**

Keyseat Cutters

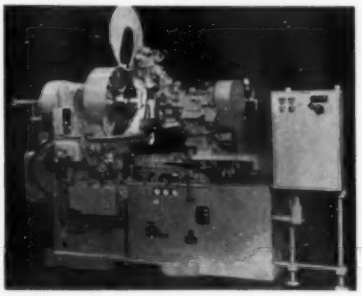
Permitting a fast cutting cycle and long runs, the carbide keyseat cutter illustrated is available in sizes from ½ to 1½-in. diameter. It has a ½ x 2¾6-in. straight shank, with an extended female center on the cutter end, permitting use of an outboard center on the milling machine overarm and adding support and rigidity. The cutter is used on high-alloy materials, heat-treated shafts, shafts with hard spots and carburized shafts.



Quality Tool Works, 760 S. Market St., Waukegan, Ill. **Circle 370**

Internal Grinder

Model 1124-JY is designed for grinding roller-bearing and ball-bearing raceways in outer bearing races, and straight bores in inner-bearing races from 1 to 20 in. in diam. Work parts are held in a shoe type centerless fixture which incorporates a rotary electromagnetic chuck with a 21-in. driver with 18 adjustable pads.



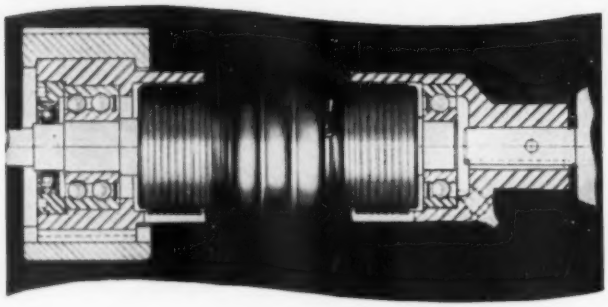
The machine has a wheel face dresser which trues wheel widths for simultaneous plunge grinding of both inner faces and bore in roller-bearing outer races. A radial diamond holder forms wheels used for raceway grinding.

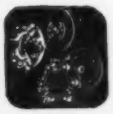
Bryant Chucking Grinder Co., Springfield, Vt. **Circle 371**

End Mills

Center cutting, heavy-duty and high spiral types are available in a line of metal cutting tools. The heavy-duty end mills with 2-in. shanks have both pin and flat drives and are available in 2-flute, 4-flute, 6-flute and ball-end styles. Two-flute, high spiral end mills are available in regular, long, extra-long and double-end styles for cutting aluminum, nonferrous metals and soft steels.

ROCKFORD




Small Spring Loaded

Heavy Duty Spring Loaded

Oil or Dry Multiple Disc

Heavy Duty Over Center

Power Take-Offs

Speed Reducers

Multiple-Disc • Single or Double • Oil or Dry Type

PULLMORE CLUTCHES

Provide

LONG WEAR LIFE

Heat-treated alloy steel provides wear-resisting bearing surfaces that are machined to close tolerances. The shifter spool has a deep slot, hardened and ground, which prolongs clutch life and reduces shifter fork wear. Discs have flat, true surfaces, free from high or low spots. Thus operating conditions remain uniform, even after long service.

Send for This Handy Bulletin

Shows typical installations of ROCKFORD CLUTCHES and POWER-TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

ROCKFORD Clutch Division BORG-WARNER

1329 Eighteenth Ave., Rockford, Ill., U.S.A.

Export Sales Borg-Warner International — 36 So. Wabash, Chicago 3, Ill.

CLUTCHES

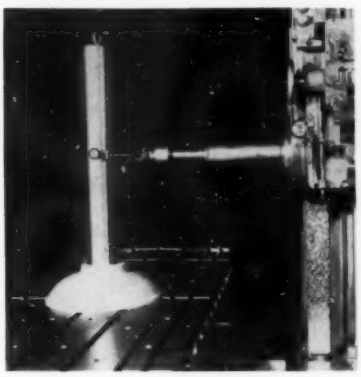
USE READER SERVICE CARD, CIRCLE 67

Four-flute center cutting end mills are available in regular, long and extra-long styles and in regular ball-end and long ball-end styles. The two-flute series and cut-to-center-hole styles are available in several sizes.

Illinois Tool Works, Tool and Instrument Div., 2501 N. Keeler Ave., Chicago 39, Ill. **Circle 372**

Aligning Tool

Placed on a machine tool table, this unit serves as a reference for checking alignment of vertical and horizontal spindles, headstocks, columns, end supports, and other machine components by means of dial indicators.

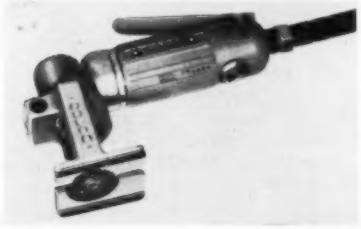


The tool is available in 36, 48 and 60-in. heights with accuracy of 0.0002 in. per foot of length. The large base minimizes problems caused by irregular table surfaces.

Davis Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. **Circle 373**

Rivet Trimmer

Originally designed for aircraft and missile work, a right-angle pneumatic tool with blind rivet trimmer attachment is suited for use in assembly of truck and house trailers, electronic chassis, boats and appliances. The attachment can be used on universal or countersunk rivets and on other similar fasteners.

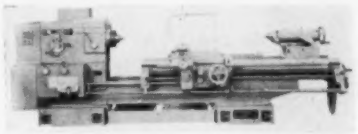


Over-all dimensions of the model 1AE tool and rivet trimmer are 5⅛ in. long, 3½ in. high and 1⅝ in. wide. Weight is 1 lb 2 oz.

Doeden Tool Corp., Sherwood, Ohio. **Circle 374**

Heavy-Duty Lathe

Model HXB 26 by 45-in. extension bed gap lathe can operate as an engine lathe with 26½-in. swing over the bedways, or as a gap lathe for large, odd-shaped parts, with 46-in. swing through the gap. A 75 percent increase in distance between centers is available by opening the gap. Distances are 48 in. with the gap closed and 84 in. with the gap open. Speeds are to 1500 rpm.



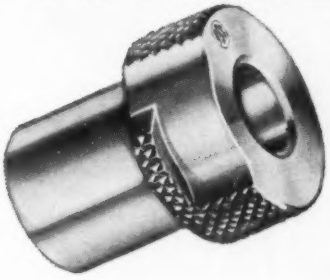
Eighteen gear-driven speeds are selected from a direct reading color index and are controlled by two levers and color speed plates.

The quick change box provides 60 different feeds from 0.0021 to 0.192 ipr; 60 thread changes from 1 to 72 tpi.

Nebel Machine Tool Corp., 3401 Central Parkway, Cincinnati 25, Ohio. **Circle 375**

USE READER SERVICE CARD ON PAGE 173 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Rx FOR HEALTHY DRILLING OPERATIONS



1 USE ACCURATE DRILL JIG BUSHINGS—made of high carbon, chrome bearing steel—exclusively.

2 INSIST UPON ACCURATE BUSHINGS—the bushings that have precision ground and honed holes—outside diameters and shoulders ground concentric and square—bushings that are consistently uniform and dimensionally stable.

3 TAKE ADVANTAGE OF ACCURATE'S SERVICE—all standard sizes shipped "same day" your order received—complete stocks maintained at factory and convenient warehouse locations.

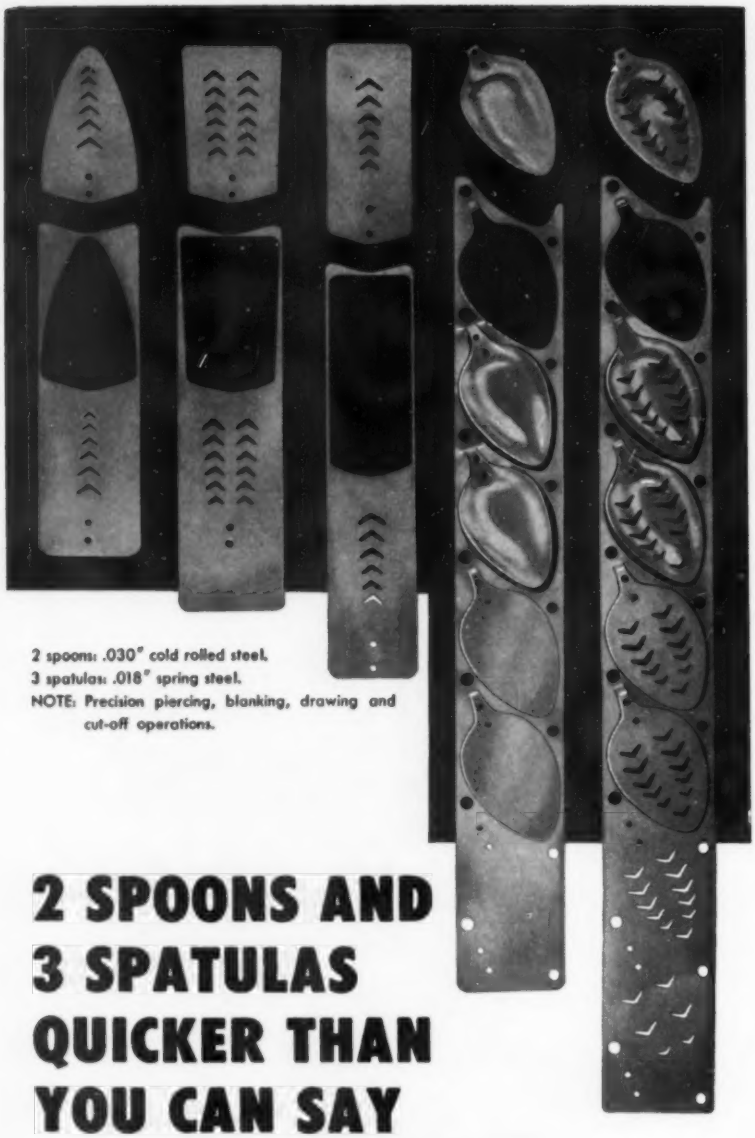
Call or write today for free ABC Bushing catalog and price list.

ACCURATE BUSHING CO.

ASA Standard Drill Bushings • Precision Parts • Lift-Swing Drilling Fixtures

443 North Avenue, Garwood, New Jersey

USE READER SERVICE CARD, CIRCLE 69



2 spoons: .030" cold rolled steel.
3 spatulas: .018" spring steel.
NOTE: Precision piercing, blanking, drawing and cut-off operations.

2 SPOONS AND 3 SPATULAS QUICKER THAN YOU CAN SAY "FLAPJACK!"

Precision mass production of mixing spoons and spatulas—modern designs for modern homemakers—products of B. Jahn "Production Proved" Progressive Dies.

One of America's foremost kitchen tool manufacturers entrusted these five dies to B. Jahn because "nothing is too good for their customers." The result, dependable trouble-free tooling, a superior product, exceptional production speed and economy.

If your product is mass produced...

If "nothing is too good for your customers"...

If dependable production and competitive economy is desirable...

B. Jahn is your source for production speed, economy and tooling ingenuity.

B. Jahn

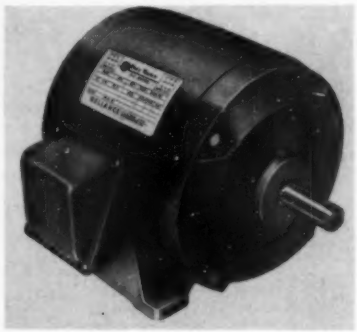
Send for colorful "Case History" Brochure

THE B. JAHN MANUFACTURING COMPANY, NEW BRITAIN, CONNECTICUT

USE READER SERVICE CARD, CIRCLE 69

Totally Enclosed Motors

Available in sizes from one through 250 hp in protected (open) weather-proof, totally enclosed, corrosion-proof and explosion-proof enclosures, these motors may be specified in all standard

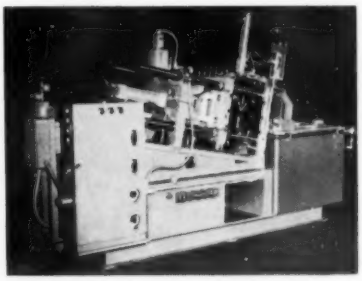


speeds and voltages. Designs include polyphase, ball-bearing, vertical and horizontal mounting arrangements with feet or footless, with NEMA C-face, D-flange or P-base brackets.

Reliance Electric and Engineering Co., 24701 Euclid Ave., Cleveland 17, Ohio. **Circle 376**

Die Caster

Completely automatic, this Model 7Z 100-ton hot chamber die casting machine produces up to 1000 shots per hour of small zinc castings. Inclined platens and injection cylinder keep nozzle drippings to a minimum and permit castings to fall freely.

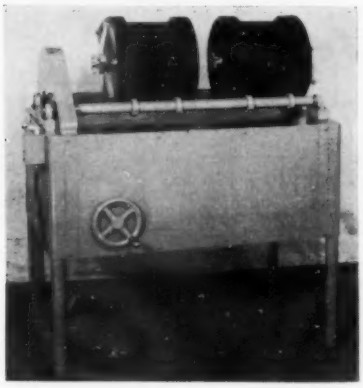


Die mounting plates are 21½ x 21½ in. Space between tie bars is 13½ x 13½ in. Maximum die stroke is 8 in. Injector cylinder stroke is 6½.

Cast-Master, H-P-M Div., Koehring Co., 23901 Aurora Rd., Bedford, Ohio. **Circle 377**

Roll Finishing Machine

Available in six basic models and larger special sizes, a roll finishing machine is designed for small volume precision finishing of small parts such as screws, washers and gear parts. The



machine uses neoprene barrels set on rollers powered by a ½-hp 110-v drive. A portable separator with media pans and screens is available.

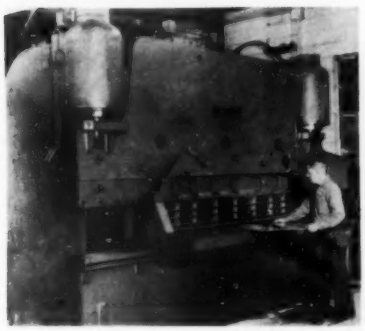
Techline Div., Wheelabrator Corp., 2400 Avenue V., Vicksburg, Mich.

Circle 378

USE READER SERVICE CARD ON PAGE 173 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Shearing Attachment

Continuous shearing of stainless and ½-in. mild steel in lengths up to 72 in. can be achieved with this shearing attachment for a hydraulic press brake.



Knife clearance can be varied. Maximum time for removal of press brake dies and installation of attachment is 30 minutes.

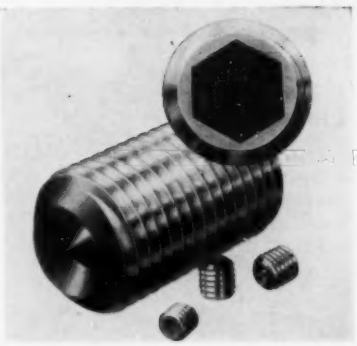
Pacific Industrial Manufacturing Co., 848 49th Ave., Oakland, Calif.

Circle 379

Socket Setscrew

A high degree of holding power is achieved through the concept of a cone point centered within the cup edge of this socket setscrew. The screw tracks evenly with a well-defined even groove, resulting in positive frictional contact of both flanks of the cup with the engaged work. The W-point, acting as a fixed point, prevents oscillation of the cup edge and minimizes the tipping effect of key tightening.

Parker-Kalon, 1 Peekay Dr., Clifton, N. J. **Circle 380**



replaceable boring and reaming cutters

Save 70% or more in tool costs and production time on holes over 5/8"

• Diameter adjustable within ¼ in. range: Blades are expandable *as they wear* for maximum tool life and accurate tolerance control. Grind blades for tolerance *only; not* for size.

• Blades replaceable: Madison slotted bars wear indefinitely. You replace blades only, with costs averaging 1/3 that of solid flute reamers. Down-time for replacement and adjustment is negligible.

• Cut tool inventory: *One* Madison slotted bar can be used on holes of *many* varied diameters . . . since each bar accommodates a broad range of cutter sizes.

• No alignment problem: Madison reamer blades *float* in the bar slot . . . are self-centering in the hole. No floating holders required, no compensation for spindle wear. (NOTE: *Boring* cutters are *fixed* in their slots . . . do *not* float.)

• Free cutting action, no chip pack-up: Generous chip clearance permits free circulation of coolant for higher speeds, finer finishes, closer tolerances.

• Multiple operations in one pass can be performed simply by spacing standard Madison blades on specially made bars. Any combination of reaming, boring, chamfering and other hole-making jobs can be completed on a *variety of diameters* . . . and in *one pass!*

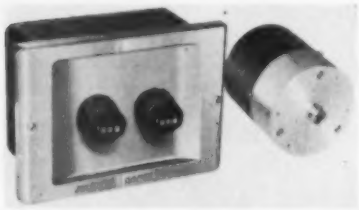
Write for further information to TE7.

MADISON *Industries* Dept. TE-10, Box 1137 Providence, R. I.

USE READER SERVICE CARD, CIRCLE 70

Limit Switch

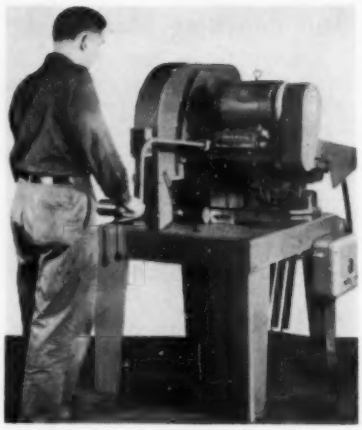
Typical applications for this electronic limit switch include machine tools, bending machines and presetting for batch weighing systems, where one or more trip points must be frequently reset. Limits are set quickly to accuracies of 1/5 of one percent of full scale for standard units or to one part in 250,000 for special high accuracy systems.



The Jordan Co., Inc., 3235 W. Hampton Ave., Milwaukee 9, Wis. **Circle 381**

Abrasive Cutting Machine

The Model 2-A cutting machine is designed for heavy-duty work in metalworking plants, steel mills, factories, and maintenance shops. The machine will cut cold and hot-rolled steel, alloy and carbon steel, stainless steel, cast iron and nonferrous metals in measurements of up to 4-in. solids, round or square; 5½-in. OD pipe or tubing; 6 x 1-in. flat stock; 6-in. angle iron; and 8-in. channels.

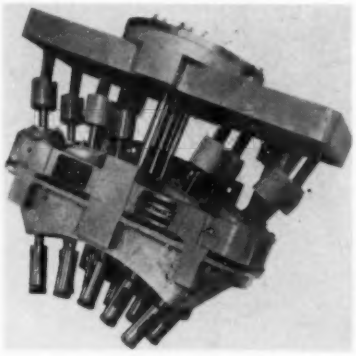


The oscillating, dry-abrasive cutting machine utilizes a 20 x ⅛ x 1-in. wheel. Rate of cut is from 2 to 3 sec per sq in. of metal cut. Floor space required is 37 x 68 in. Net weight is approximately 1300 lb.

Allison-Campbell Div., American Chain & Cable Co., Inc., 929 Connecticut Ave., Bridgeport 2, Conn. **Circle 382**

Angular Drillhead

This head drills holes at an angle at the same time straight holes are being drilled parallel to the direction of the machine feed. Ten spindles are equally spaced in two straight rows.

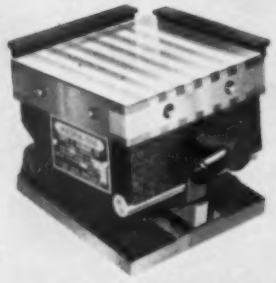


To permit drilling of all holes radially, each pair of spindles is at an 11-deg angle with the adjacent pair. An included angle of 44 deg exists between the pairs of outside spindles. The main body of the head remains stationary.

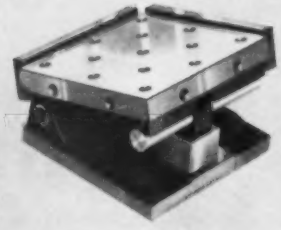
Thriftmaster Products Corp., 1004B N. Plum St., Lancaster, Pa. **Circle 383**

NEW SMALL SIZE

LOWER COST, FASTER ACCURATE ANGULAR SET-UP OF SMALL WORK



Magna-Sine (Model B-3-MS) With 4" x 4" Working Area



Sine Plate (Model B-3-SP) With 4" x 4" Working Area

ROBBINS MAGNA-SINE

This new smaller Magna-Sine has all the time-saving, accurate angular set-up features found in larger Robbins Magna-Sines. Small to medium size work can now be set up in minutes instead of hours and with a lower investment in equipment. Magna-Sine table has a strong, fine pole, permanent magnet chuck that firmly holds small work without distortion.

ROBBINS SINE PLATE

Robbins small Sine Plate is manufactured to the same high standards of accuracy as the Magna-Sine. This precision makes it ideally suited for angular inspection set-ups. The ground surface of the non-magnetic table has tapped holes for convenient clamping of any work. Also, sturdy construction makes this small Sine Plate extremely suitable for light machining operations.

Compound angles are quickly and easily set up with this Robbins equipment by combining either two Magna-Sines, a Magna-Sine with a Sine Plate, or two Sine Plates. Now, with lower initial investment, every shop can secure accurate angular set-ups for small work. With Robbins equipment, you do a better job, faster and at less cost.

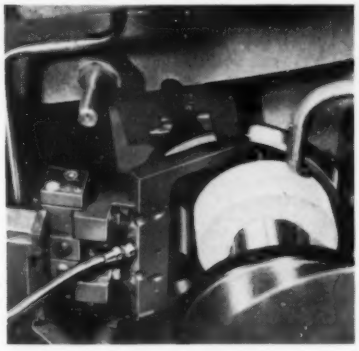
OMER E. Robbins COMPANY
11961 DIXIE AVENUE DEPT. E DETROIT 39, MICH.

USE READER SERVICE CARD, CIRCLE 71

USE READER SERVICE CARD ON PAGE 173 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Automatic Grinding Gage

"Air-fork" design provides easy and effective size-control gaging on internal grinders for work down to 1¼ in. The shape of the head permits it to remain in straight or tapered work continuously without interfering with the reciprocating action of the wheel. This eliminates the need for the mechanical contact caliper customarily used.

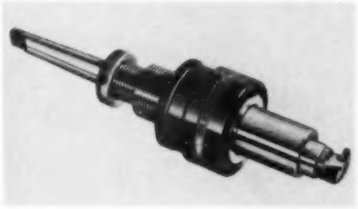


In a typical installation, the wheel grinds at a fast rate until the workpiece is about 0.0005 in. oversize. At this point, the gage signals the machine control to retract and dress the wheel. Grinding is then resumed at the finish rate. The wheel is automatically retracted when the gage signals that final size has been reached.

Federal Products Corp., 6125 Eddy St., Providence 1, R. I. **Circle 384**

Recessing Tools

Designed for use on standard drill presses, radial drills and special machines, a line of automatic recessing tools eliminates need for complex special tooling in intricate machining operations. Two basic types and seven sizes cover work hole diameters from ¼ to 4½ in. and up to 0.300-in. depth of cut.



Both types are available with either eccentric or concentric tool mounting. Interchangeable parts increase the work range of the tools.

Scully-Jones and Co., 1901 S. Rockwell St., Chicago 8, Ill. **Circle 385**

Fastening Tool

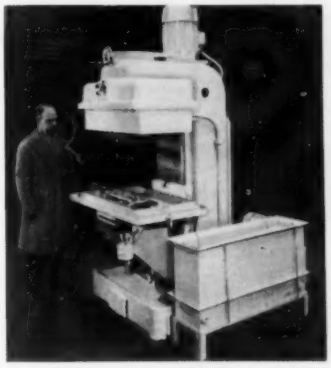
Model 115 manually operated fastener installation tool is capable of developing 6000-lb pulling force. It is operated by simple application of standard wrench to ball screw projection as shown. The tool installs all Huck fasteners from 5/32 to 3/8-in. nominal diameter in both steel and aluminum, with the exception of the conical keystone lock blind rivet.

Over-all length without nose assembly is 7½ in. Total weight with nose assembly is 5¼ lb. Length of stroke is 1¼ in.

Huck Mfg. Co., 2480 Bellevue Ave., Detroit 7, Mich. **Circle 386**

Drilling, Boring Machine

This drilling and boring machine is equipped with a spindle drive that eliminates gearing in the quick-change heads and permits use of relatively low-cost head assemblies, spindles and parts.



Available heads are 18 x 36 in. and 9 x 14 in. Tolerances to 0.0002 in. can be held. Cartridge sizes are ¼, ½, ¾ and 1 in. diam., requiring minimum center distances of 9/32, 17/32, 25/32 and 1 in. respectively.

Sunstrand Machine Tool Div., Sunstrand Corp., Belvidere, Ill. **Circle 387**

You can't afford it!

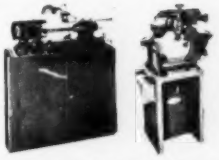
As the pictures show, taps cost roughly 6 times as much as drills. Yet it's common practice to resharpen the drill — and throw away the tap.

It doesn't make sense. And it's an awful waste of money.

That's where Blake comes in.

Blake makes low cost, high-precision tap grinding equipment. These easy operating tools can make your taps last up to 6 times longer . . . reduce work spoilage . . . enable taps to cut more accurately and uniformly with less strain . . . cut tap costs as much as 65%.

It's surprising how many people overlook this proven, basic method of saving money. Be sure you don't. Ask us for complete information.



Blake Chamfer Grinder/Blake Flute Grinder used in combination, create or restore:
1. exact indexing of cutting edges.
2. controlled rake angles for each job.
3. correctly ground spiral points.
4. perfectly relieved chamfers . . . make one tap do work of six!

EDWARD **BLAKE** COMPANY, INC., DEPT. 13, 570 PLEASANT ST, WATERTOWN, MASS.

USE READER SERVICE CARD, CIRCLE 72

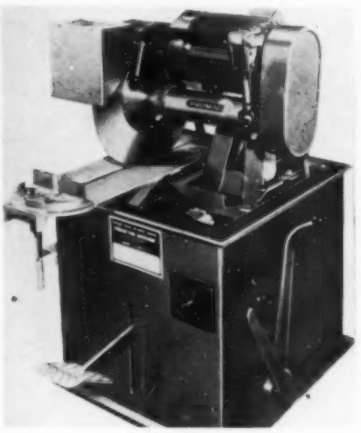
Cylindrical Grinder

Capacity of this machine is 3 x 12 in. between centers and a swing of 5 in. Finishes to 3 microinches and repetitive accuracy to 0.0007 in. are obtainable. Parallelism and roundness are held to millionths. The MG12 is designed for precision grinding of small manufactured parts.

Bentley Industrial Corp., 41 East 42nd St., New York 17, N. Y. **Circle 388**

Cutoff Saw

Steel slicing is accomplished without clamping, hold-down or the use of coolants, since the high speed of this saw eliminates drag and heat. Typical cutting speeds on mild steel are: 2 x 2 x ¼ in. angle, 1 sec; 6 x ½ in. flat bar, 2 sec; 1⅜ in. diam bar, 3 sec; and 6 in. x 12.5# I-beam, 9 sec.

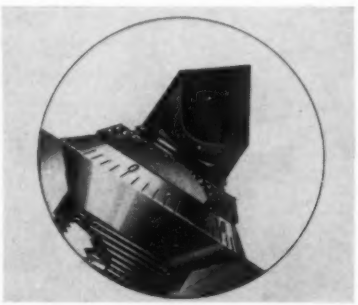


Single cut capacity includes 4 x 4 x ½ in. angles; 12 in. x 20.7# channels; 6 in. x 12.5# I-beams; 1⅝ in. diam bars; and 12 x ½ in. plates. Larger pieces can be cut by a second pass.

Production Machinery, Inc., P. O. Box 322, Oakton Station, Des Plaines, Ill. **Circle 389**

Boring Tools

Titanium carbide or ceramic tips are provided on microbore tools. These new cutting tool materials permit higher

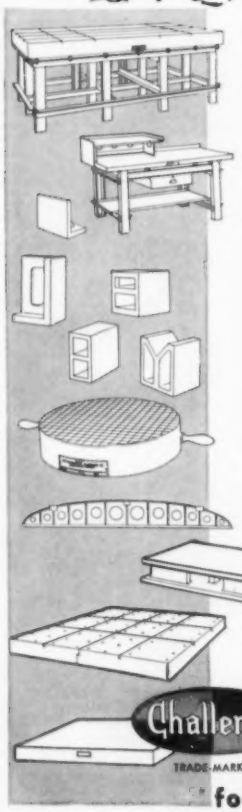


feeds and speeds and give smoother finishes than with conventional tool materials.

DeVlieg Microbore Div., DeVlieg Machine Co., Fair St., Royal Oak, Mich. **Circle 390**

need to hold CLOSER TOLERANCES?

HERE ARE OVER
300 AIDS to
PRECISION
PRODUCTION



More than 300 different items are available in the Challenge Precision Surface Equipment line to help you maintain close control of accuracy in your tooling, manufacturing assembly and inspection operations.

These include both Granite and Semi-Steel Surface Plates of all types and sizes. Also Semi-Steel Angle Plates, V-Blocks and many other items of precision surface equipment. In addition, many special sizes and types can be made-to-order.

Take this important step toward cutting costs and minimizing rejects. Get information on Challenge Precision Surface Equipment to improve your operations.

SEND FOR THIS HANDY FREE CATALOG
covering description and prices on all standard items.

THE CHALLENGE MACHINERY CO.
GRAND HAVEN, MICHIGAN

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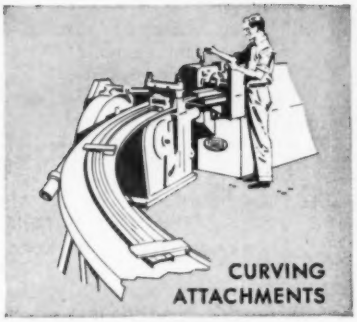
challenge
Challenge TRADE-MARK ®
PRECISION SURFACES
for LAYOUT • INSPECTION • ASSEMBLY

USE READER SERVICE CARD, CIRCLE 73



YODER COLD ROLL-FORMING EQUIPMENT

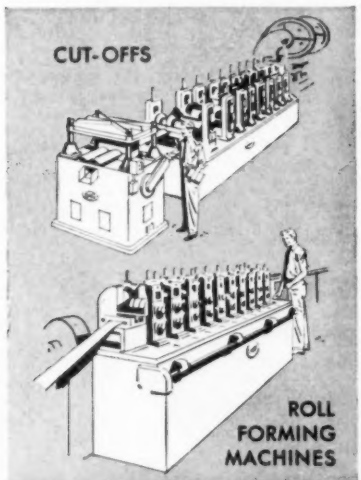
for profitable mass production

High speed, YODER Cold Roll-Forming machines are the most economical method for mass producing structural or ornamental shapes. One machine with one operator can form up to 40,000 feet of shapes per day. Even on a part-time basis, a YODER Cold Roll-Forming machine can prove to be a profitable investment.

YODER flexibility works for you too, curving, coiling, ring forming, multiple roll-forming and embossing—on a wide variety of metals—can be incorporated into your production line. Practical, YODER-engineered design minimizes maintenance and downtime... assures uniformity, accuracy and reliability of your end product.

In addition to Roll-Forming machinery, YODER also makes a full line of Rotary Slitting equipment, Pipe and Tube mills. Send for the fully descriptive Cold Roll-Forming Book.

THE YODER COMPANY
5525 Walworth Ave. • Cleveland 2, Ohio

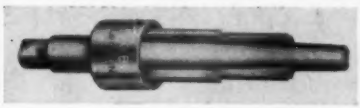


ENGINEERING YODER MANUFACTURING
COLD ROLL FORMING MACHINES

USE READER SERVICE CARD, CIRCLE 74

Jaw Mandrel

The GB wide range, straight jaw mandrel needs 14 tools for a range of ⅜ to 3¼ in. diameters. The mandrel is



useful for smaller shops and tool rooms and experimental, repair and maintenance operations of larger industries. Tolerances are within 0.001 in., tir.

Le Count Tool Works, Inc., 38 Cody St., West Hartford 10, Conn. **Circle 391**

Bolt, Screw Shims

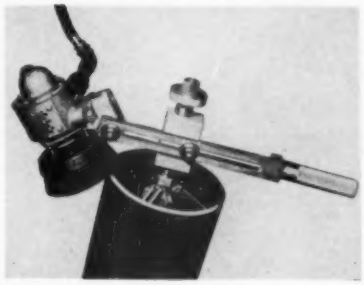
Packed in a plastic, sectioned box are ready-to-use spring steel lengthening and shortening shims for adjusting die stripper bolts or shoulder screws. Insertion establishes correct stripper plate height after grinding. Six sizes in decimal thicknesses are in assortment.

Detroit Stamping Co., 340 Midland Ave., Detroit 3, Mich. **Circle 392**

USE READER SERVICE CARD ON PAGE 173 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Bevel Grinder

Six to 18-in. diam pipe can be weld-beveled on the job with a grinder which does not change the properties of steel, stainless steel, high-alloy steel or aluminum. The grinder head can be set at 20, 37½ and 90 deg by a locking pin in the motor support. Other angles are set by locking the grinder head with a socket-head capscrew.



Guarded 6-in. cupped grinding wheel is powered by a 6000-rpm air motor.

The E. H. Wachs Co., 1525 N. Dayton St., Chicago 22, Ill. **Circle 393**

SERIES 101A

AIR 150 PSI
HYDRAULIC UP TO 1500 PSI
MEETS JIC STANDARDS

By fitting into one-third less space than a tie-rod cylinder of the same bore, this original O-M space-saving component gives greater flexibility to design, reduces weight and cuts installation time.

But there are many other reasons for using this O-M Round-line Cylinder that delivers smooth, dependable power. It has the lowest coefficient of friction . . . assures full-power starts . . . is sealed right—ports are easily oriented independently to 360 degrees . . . and, end plugs are tapped for universal mounting. Easily modified for special applications at a nominal extra over standard cylinder prices. Internal locking key makes it easy to disassemble, service and reassemble with no alignment problems.

Available for Air or Hydraulic circuits in a complete range of sizes (1¼" to 8" bores) with standard, 2 to 1 or oversize rods. All-steel construction with bearing bronze. Completely interchangeable parts. Immediate delivery on many sizes.

Mail coupon at once for Bulletin 101A containing engineering drawings of cylinder, mounts, mounting brackets, capacity chart and other data.

ORTMAN-MILLER MACHINE CO.

13 143rd Street,
Hammond, Indiana

☐ **Have representative call**
☐ **Send Bulletin 101A**

Name_____ Position_____

Company_____

Address_____

City_____ Zone____ State_____

USE READER SERVICE CARD, CIRCLE 75

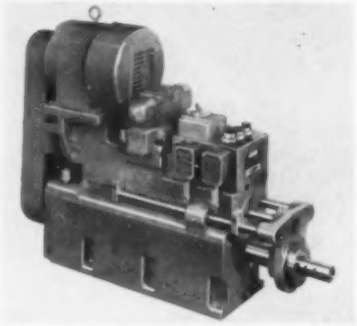
Vacuum Coater

Small-lot vacuum metallizing operations on plastic, glass and metal parts can be handled by this Model 3142 production coater. A horizontal 24 by 30-in. coating chamber is mounted on a cabinet which contains the electrical system. It has conveniently grouped controls and an external pumping system. A 10-in. diffusion pump and a 30-cfm rotary gas ballast pump have high pumping speeds. The coater is available with either a motor-driven rotary jig or hand-operated jig. Controls are centrally located at operator level.

NCR Equipment Corp., 160 Charlemont St., Newton 61, Mass. **Circle 394**

Power Unit

Most of the components used in this self-contained, quill type hydraulic power unit are standard. The unit can be used for single or multiple drilling, reaming, counterboring, spotfacing and limited boring, milling and similar operations. Maximum spindle thrust is 2455 lbs at 500 psi operation. Total stroke is 12 in. with 4-in. feed stroke adjustable from 1.5 to 180 ipm.



F. Jos. Lamb Co., 5663 E. Nine Mile Rd., Detroit 34, Mich. **Circle 395**

Core Material

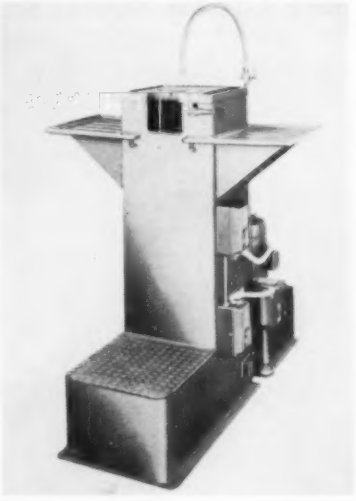
Multiwave core material is used in the construction of a variety of production tools including welding jigs, holding fixtures, large molds for the forming of plastic and light metal parts, master tools, and drill and check fixtures. Advantages of the tools are light weight and flexibility. They are made up of sandwich panels with thin skins of reinforced plastic on both sides of the hollow Multiwave core. Multiwave will drape over complex molds and shapes, including those with compound curves.

Narmco Resins and Coatings Co., 600 Victoria St., Costa Mesa, Calif. **Circle 396**

USE READER SERVICE CARD ON PAGE 173 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Broaching Machine

Model VM215-3 vertical table-top broaching machine is fully hydraulic with a 15-in. cutting stroke, 15-fpm cutting space and 36-fpm return speed.



Normal power is rated at two ton. The worktable is 16 x 16 in. and the complete machine requires floor space of 42 x 53 in.

Pioneer Broach Co., 6434 Telegraph Rd., Los Angeles 22, Calif. **Circle 397**

5 Basic Reasons why
MARVEL HACK SAWS
CUT-OFF MORE ACCURATELY...

The consistently accurate performance of MARVEL Heavy Duty Hack Saws is no accident. MARVEL engineers knew, many years ago, that to produce and maintain accurate cutting-off, a hack saw must be designed and built like a fine machine tool.

Some of the basic design principles built into the modern MARVEL Hack Sawing System that makes it the most accurate cutting-off method you can use are:

1. V-Way Design...Greater Rigidity

Upright and Saddle are precision machined and fitted to form a rigid, integral unit capable of withstanding any cutting load with no deflection or side movement.

2. Anti-Friction Bearing Construction

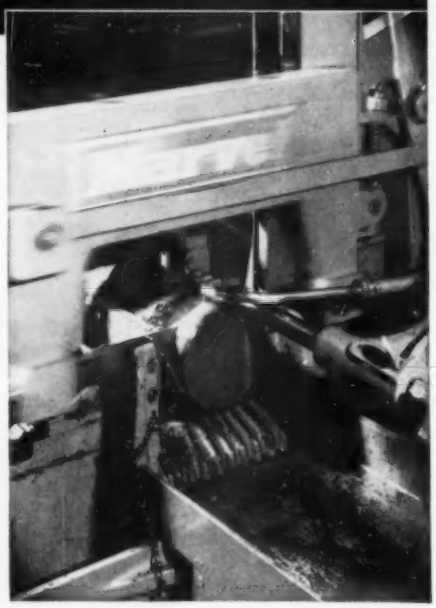
Anti-friction ball or roller bearings are used at all load carrying points. Even the strongly braced saw frame reciprocates on heavy duty, fully enclosed preloaded ball bearings which provide permanent, frictionless rigidity and true-running, straight line cutting strokes.

3. Minimum Blade Frame Reach

Close-coupled design and crank lever action of MARVEL Saws keeps the saw frame and blade reach very short in relation to the vertical V-ways on which the unit is mounted. This insures optimum rigidity, even under the most severe operating conditions.

4. Positive Relief Blade Lift

On the return stroke, positive relief lift raises the blade to provide proper and "cushioned" load-in on the next cutting stroke. This prolongs blade sharpness, life and accuracy.



5. Rigid Cutting Tool

Cutting-off accuracy requires a rigidly held, relatively short cutting tool. MARVEL Unbreakable High-Speed-Edge Hack Saw Blades, which combine a narrow high speed steel cutting edge permanently welded to a tough alloy steel body, can be tensioned from 200% to 300% more than ordinary blades. This provides a most rigid cutting edge.

Catalog C85 has complete details, facts and figures on both Marvel metal cutting Hack Saws and Band Saws. Write for it today.

PR-1360

MARVEL Metal Cutting SAWS
Better Machines—Better Blades

ARMSTRONG-BLUM MFG. CO.
5700 W. BLOOMINGDALE AVE., CHICAGO 39, ILL.
USE READER SERVICE CARD, CIRCLE 76

Vertical Mill

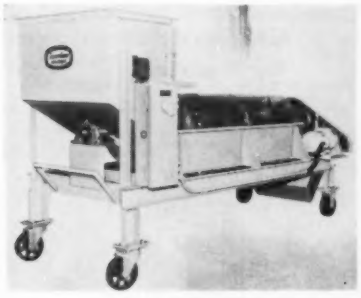
Equipped with a swivel head, this mill is capable of angular as well as vertical operations. The ram and turret machine has a 7 by 27 in. table with longitudinal feed of 16 in., crossfeed of 8 in., vertical feed of 15 in. and ram movement of 12 in. Quill travel is 4 in. Maximum distance from the spindle nose to the face of the column is 16 in. Maximum distance from the nose to the top of the table is 18 in.

V-belt drive transmits full power of the ¾-hp motor at all six spindle speeds, from 250 to 3450 rpm or alternately 185 to 2550 rpm.

The U. S. Burke Machine Tool Division, Brotherton Road at Pennsylvania R.R., Cincinnati 27, Ohio. **Circle 398**

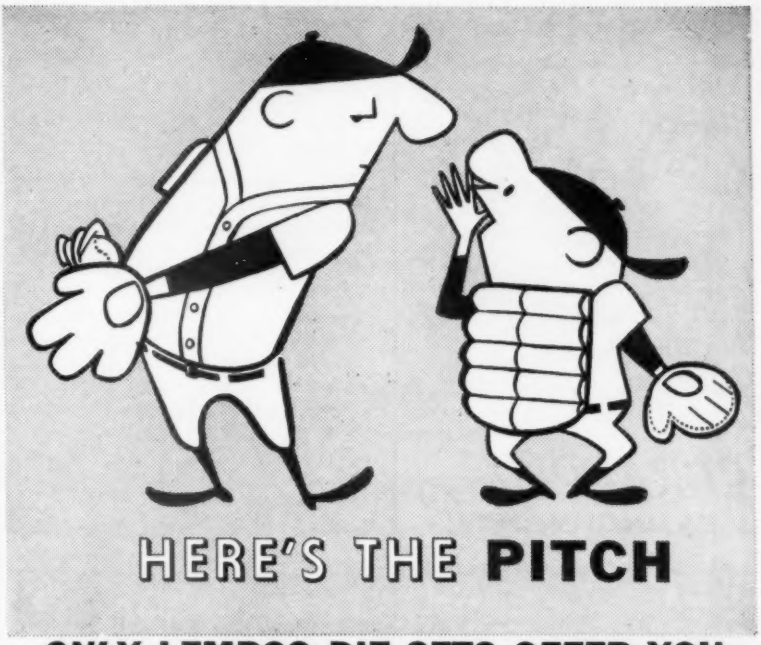
Media Classifier

Three grades of media can be resized automatically at rates of up to 6000 lb per hour with the Model PCL-3 portable

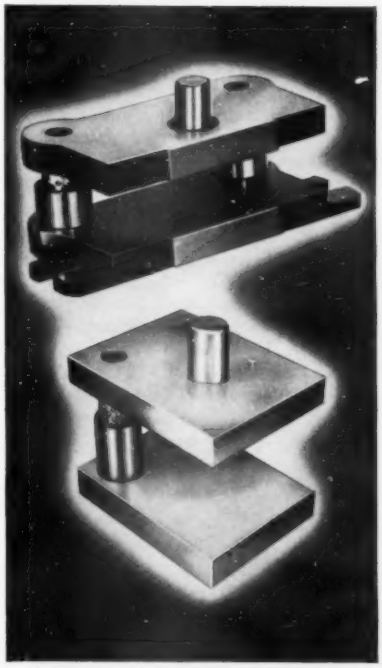


media classifier. Interchangeable screens are available for classifying a complete range of media sizes.

Almco-Queen Products Div., King-Seeley Corp., Albert Lea, Minn. **Circle 399**



***ONLY* LEMPCO DIE SETS OFFER YOU "MINIMUM MAINTENANCE" OPERATION**

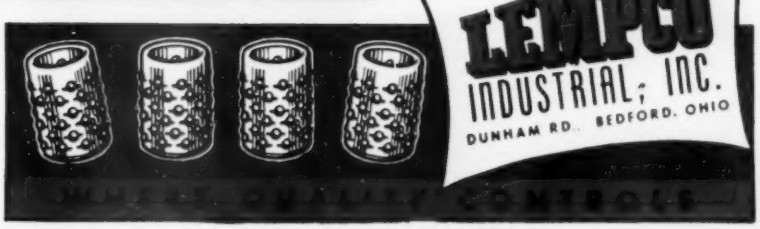


Operating on Ball Bearing Bushings, with Aluminum Alloy Retainers, Lempco Die Sets deliver millions of strokes, retaining phenomenal precision of alignment, requiring only an occasional dab of grease for lubrication.

NO OTHER DIE SETS HAVE LEMPCO FEATURES!

Better look at those Lempco "M" and "L" style die sets, too; they're *all-steel* yet sell for the price of cast iron.

Write today for Catalog and Price Lists.



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SCRAPPED . . .
BY INCHWORM!

brings an entirely new concept of precision and closer tolerances to the machine tool industry.

Many leading producers of precision machined parts have replaced centerless grinder lead screws with INCHWORMS to achieve:

- **tolerances to ± .000025"**
- **elimination of *backlash***
- **lower production costs**

The INCHWORM Motor works on the principle of magnetostriction, enabling the machine tool operator to advance or retract the tool in microscopic increments by simply pushing a button. An easily read dial gives him control, with 50 times the accuracy possible with a conventional lead screw. And, he doesn't have to take time to retract the lead screw and slowly advance it again—he gets final size simply by pushing the button.

AT NO EXPENSE TO YOU . . .

The INCHWORM Motor can be installed on your centerless grinder in less than an hour —and prove itself almost immediately. We will install it in your plant, *on approval*, upon the recommendation of our sales engineer.

Send for the complete story!

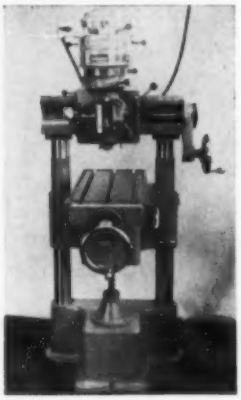
AIRBORNE INSTRUMENTS LABORATORY
1345 NEW YORK AVENUE
HUNTINGTON STATION, L. I., N. Y.
A DIVISION OF CUTLER-HAMMER, INC.

USE READER SERVICE CARD, CIRCLE 78

TOOLS of today

V-Mill

Table dimensions of this V-mill are 14 x 36 in. with 20-in. travel. The range is 16-in. cross travel, 17-in. vertical and 4-in. spindle travel. Horizontal space between columns is 17½ in. Five-in.

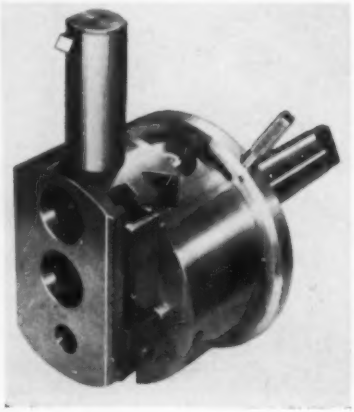


engraved deals are graduated in thousandths of an inch. The mill has positive approach and locking. It is available as standard, with 1-hp Bridgeport, 8-speed, milling, drilling and boring head. Other milling heads are available as optional equipment.

Williams and Hussey Machine Corp., Clinton St., Milford, N. H. **Circle 400**

Boring Heads

Continuous-feed heads for small-diameter boring, facing, turning, counter-boring, backfacing, grooving and chamfering operations have uninterrupted radial feed and give high accuracy. Designed for use with all types of rotating-spindle machines, they cover



● ACTUAL MANUFACTURERS OF RESINOID METAL AND VITRIFIED DIAMOND WHEELS UP TO AND INCLUDING 24" DIAMETERS

Call or write for literature today!

TRADE MARK
THE P. L. KUZMICK CO. VERONA, N.J.

THE PAUL L. KUZMICK COMPANY
271-279 GROVE AVE.
VERONA, N.J.

● MANUFACTURERS OF RESINOID AND RUBBER BONDED WHEELS SERVING THE AIRCRAFT, CUTLERY AND STEEL FABRICATING INDUSTRIES.

Call or write for literature today

P K

PEKAY ABRASIVES, INC.
271 GROVE AVE.
VERONA, N.J.

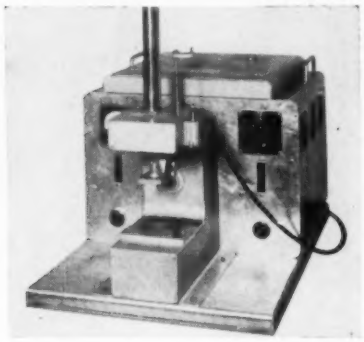
USE READER SERVICE CARD, CIRCLE 79

a range of diameters from 7/16 in. (with a pencil boring tool) to a recommended maximum of 25 in. Radial feed is adjustable to 0.0001 in. or finer.

Davis Div., Giddings & Lewis Machine Tool Co., Fond du lac, Wis.
Circle 401

High-Frequency Heaters

Small vacuum type high-frequency heating units, weighing less than 80 lb, are intended for laboratory and light production functions. Model L4C induction generator puts out ½ kw for heating metals. Model C-63 dielectric



generator puts out ½ kw for heating nonconductors such as plastic and resins. Both have full control over power output and time cycles. Special work coils and dies are available

Reeve Electronics, Inc, 609 West Lake St., Chicago 6, Ill. **Circle 402**

Carbon Tool Steel

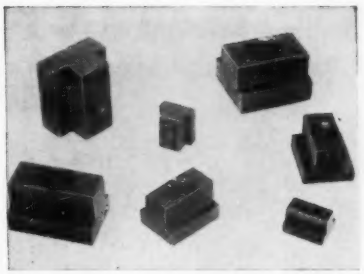
Vanadium carbides have been added to a 0.90 percent carbon tool steel for cold heading applications such as the high-speed, long-run production of nuts, bolts and rivets. Wear-resistant qualities make the steel useful for cold striking dies, cold coining dies, tube drawing dies and mandrels, rotary swaging dies, hammers and rolls, and punches.

The vanadium carbides restrict grain growth to retain a fine fracture size when hardening temperatures are elevated to as high as 1700 F.

Latrobe Steel Co., Latrobe, Pa.
Circle 403

T-Nuts

T-nuts are fabricated from rolled 4150 steel, heat treated for tensile strength of 170,000 psi and machined to fit any table slot. Stock size thread ranges run from 3/8-16 to 7/8-9; over-all height, 5/8 to 1¼ in.; width, 1 to 2 in. and depth, 7/8 to 1¾ in. A built-in

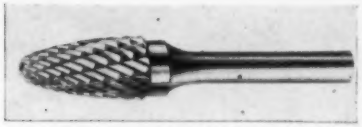


safety stop, made possible by a special thread treatment, blocks the stud at maximum depth. This prevents damage to machine tables caused by studs "turning through."

Jergens Tool Specialty Co., 712 E. 163rd St., Cleveland 10, Ohio.
Circle 404

Carbide Cutter

Alternate-diamond pattern design with coarse cut grind permits fast cutting action without producing splinters when this tool is used in weldment



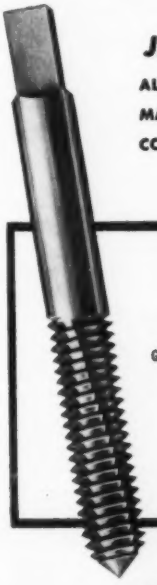
work. The cutter provides fast penetration and increased stock removal. It can be reground with minimal diameter loss per regrind.

M. A. Ford Mfg. Co., Inc., Davenport, Iowa. **Circle 405**

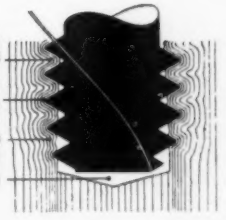
NEW IDEA IMPROVES COLD-FORMING TAPPING

JARVIS PRESENTS NEW *JAR-FLO* TAPS FOR CHIPLESS FORMING (INSTEAD OF CUTTING) OF THREADS IN THRU OR BLIND HOLES

*EXCLUSIVELY
JAR-FLO
Unique design with lobes, or pressure contact points, gives true geometrical contact. Lobes are generated on Helical Ground Threads to give progressive working of metal and smooth burnished finish.



***JAR-FLO* TAPS FOR**
ALUMINUM — ZINC—LEAD
MAGNESIUM — LEADED STEELS
COPPER—BRASS — DIE CASTINGS
& OTHER DUCTILE METALS



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***JAR-FLO* ADVANTAGES**
1. NO CHIPS
2. FASTER TAPPING CYCLES
3. HIGHER TAPPING SPEEDS
4. LESS DANGER OF BREAKAGE IN TAPPING BLIND HOLES CAUSED BY CHIP INTERFERENCE.
5. LONGER TAP LIFE REDUCES COSTS
6. ELIMINATES SHAVED AND OVERSIZED THREADS

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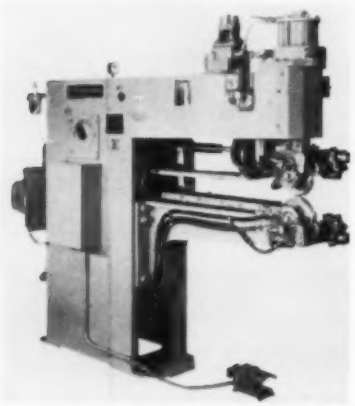
Seam Welders

Available in three sizes ranging from 50 to 400 kva inclusive, each size seam welder is available as a circular, longitudinal or universal machine in a range



of standard throat depths and transformer sizes. These machines are intended for high-production applications.

Bulletin S-59, The Federal Machine and Welder Co., Warren, Ohio.

Circle 406

Locator Light

Used to accurately and quickly pinpoint a work area with a beam of light, this locator device is adaptable to drill presses, terminal setters, punches, riveting machines and similar equipment.

Equipped with transformer, prism, long-life bulb and mounting bracket, the adjustable light is 3½ in. long.

Black & Webster, Inc., 570 Pleasant St., Watertown 72, Mass. **Circle 407**

Drilling Machine

Operating from a master template, this automatic printed circuit drilling machine will operate at a rate of 60 patterns per minute. Circuit boards can be drilled individually or stacked to a height of 2 in. for simultaneous drilling. Drilling and clamping cycles are

automatic and integrated. Length of stroke is 0 to 2 in. Speed range is 400 to 7420 rpm.

Sullivan Automatic Specialties, Inc., 6705 Fourteenth Ave., Kenosha, Wis.

Circle 408

Riveter

A lightweight "shock absorber" air-powered riveter covers a wide range of light riveting, chipping, scaling, calking and nail-driving operations. The riveter comes in four power ratings with a choice of seven throttle handles, including offset design, pistol grip, and button throttle handles. Capacities range from ⅛ to ¼ in. diameter cold rivets of aluminum, dural or soft iron.

Ingersol-Rand Co., 11 Broadway, New York, N. Y. Request form 5259.

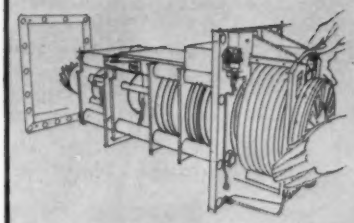
Circle 409

USE READER SERVICE CARD ON PAGE 173 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

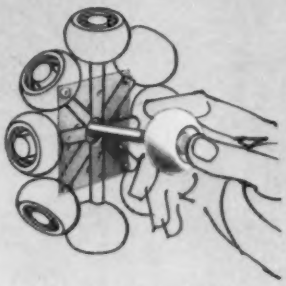
Vibratory Finishing Machine

Vibraslide 5 vibrating-rotating machine has a capacity of 5 cu ft. With the cylinder at rest and only the vibrators in operation, the chip load speed is between 6 and 12 rpm. Speed of the 3 hp vibrator is 2300 cycles per minute. Ends of the barrel are synchronized with timing belts for uniform vibration throughout the media. Dimensions are 67 by 42 by 40 in. high.

B. W. Elliott Manufacturing Co., Inc., Binghamton, N. Y. **Circle 410**



Teletorque transmission—A completely new and advanced concept in power transmission. Coaxial design makes possible a compact machine that is more rigid and more productive. Constant-mesh gears are automatically "linked" in combinations which provide 32 table speeds through electromagnetic clutch brakes.



Directional "joy-stick" control—A magic circle "joy stick" at each control center speeds operation and eliminates fatigue. The tool goes the way the operator moves the stick. Increases skill and reduces learning time.

Fastest VTL

- 34", 42", and 52" sizes
- Broadest feed range
- Highest and broadest speed range
- Single dual-direction feed and traverse handwheel
- Circular scales and microdials
- Directional rail controls at the operator's station
- Fully gibbed rail—always level
- Counterbalanced heads
- Integral bed and column
- Least floor space
- Constant cutting speed available with a-c drive
- First VTL available with numerical control

Symbol for machining cost reduction

GIDDINGS & LEWIS

VTL-101

USE READER SERVICE CARD, CIRCLE 81

Photo courtesy The Chapman Valve Mfg. Co., Indian Orchard, Mass.

...change feeds and speeds "on the fly"
...eliminates stop-and-go machining

Here is a totally new kind of vertical turret lathe—the world's most compact, fastest, and easiest to operate! It's powered, constructed, and geared for highest cutting speeds to slash the cost of boring small holes, turning long pieces, and facing wide surfaces. All functions are actuated and controlled electrically with simplicity that saves hours of hard work and puts more parts on the floor at the end of the day.

You can change feeds and speeds while the tool is in the cut and the table is turning. Tool life, finish, and accuracy are improved because the operator always works at the right speed. Now you can capitalize on throwaway tooling, not only by increasing cutting speeds, but by eliminating stop-and-go machining.

With a G&L VTL minimum time is spent with the machine idle or cutting air. As a result, the operator spends more time doing productive work.

Controls are in an ellipse area for fast, easy operation. One-hand pendant control operates the table, including speed, start, stop, and jog. The machine is easy to get around, takes 30% less floor space than machines of comparable capacity.

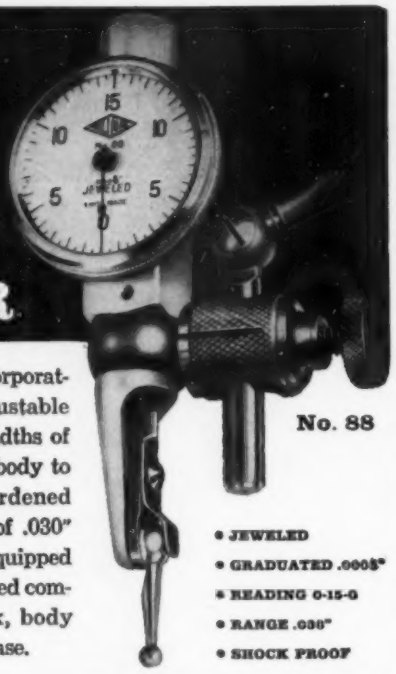
For complete details and descriptive literature, call your Giddings & Lewis distributor or write directly to the factory.

GIDDINGS & LEWIS MACHINE TOOL COMPANY

Fond du Lac, Wisconsin

Giddings & Lewis manufactures: vertical and horizontal boring machines, vertical turret lathes, planers, planer mills, contour milling machines, die sinking machines, drilling machines, numerical and tracer control systems, boring tools and related items, and machine tool accessories.

ALINA DIAL TEST INDICATOR



A fully reversible indicator incorporating a clear easy-to-read, adjustable dial, graduated in half thousandths of an inch, a switch lever on the body to reverse action and TWO hardened chrome plated contact points of .030" and .100" diameter that are equipped with a non-slip ratchet. Furnished complete with a universal shank, body clamp, and plush lined steel case.

No. 88

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- READING 0-15-0
- RANGE .030"
- SHOCK PROOF

ALINA WRITE FOR LITERATURE AND COMPLETE CATALOG

ALINA CORPORATION

122 East Second St., Mineola, L.I., N.Y.

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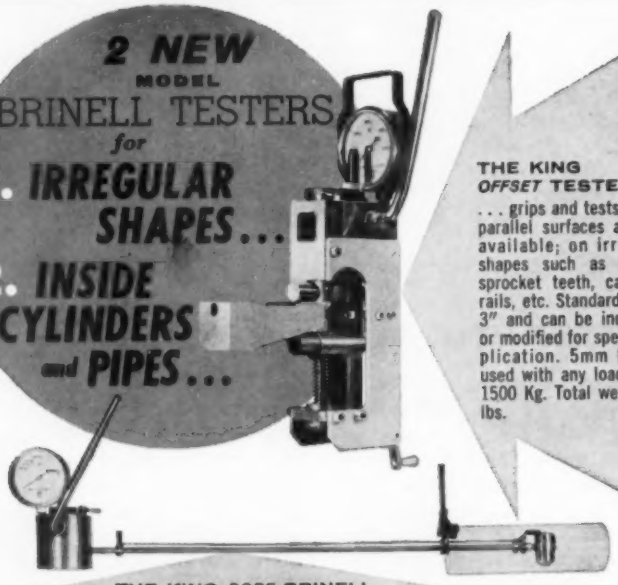
2 NEW MODEL BRINELL TESTERS for

1. IRREGULAR SHAPES...

2. INSIDE CYLINDERS and PIPES...



THE KING *OFFSET* TESTER

. . . grips and tests where parallel surfaces are not available; on irregular shapes such as beams, sprocket teeth, castings, rails, etc. Standard gap is 3" and can be increased or modified for special application. 5mm ball is used with any load up to 1500 Kg. Total weight 20 lbs.

THE KING *BORE* BRINELL

. . . employs a new King Test Head with extension holding indenting ball that can be inserted into cylindrical openings 2" to 7" in diameter, and to any desired depth. Load can be varied from 125 Kg. to 1000 Kg. Total weight 15 lbs.

Write for complete literature and prices to Dept. TE-10.

KING TESTER CORPORATION 440 N. 13th St., Phila. 23, Pa.

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.....readers' viewpoints

. . . heart surgery

To The Editor:

The article, "Heart Surgeons Seek Tool Engineering Help" appeared in a recent edition of THE TOOL ENGINEER. One of the problems outlined was the need for the ideal shunt clamp.

We in the aircraft industry are constantly working with contoured surfaces and can see no difficulty in sculpturing the fine teeth shown on one clamp onto the contoured surface of the other clamp. A precise and relatively cheap method of accomplishing this is with the use of the epoxy plastics.

I would appreciate the details of the problems involved so that we may offer a solution and possibly a working model.

William Lamberta
Grumman Aircraft Eng. Corp.
Bethpage, L. I.

Any information or requests pertaining to this heart surgery problem will be forwarded to Dr. Crook of the Cardio-Vascular Foundation in Ann Arbor, Mich. Data on the current problems being investigated by the medical and engineering personnel can be obtained by contacting either Dr. Crook or THE TOOL ENGINEER.—Ed.

. . . squandering human resources

To the Editor:

America is a nation of youth worshippers, borne out by the cosmetics industry which has become a billion dollar industry. American industry thinking is archaic when it comes to personnel evaluation. Emphasis is predominantly upon how young the applicant is and how many college degrees he has.

Nine out of ten times, the younger applicant is selected over an older one. Practically no consideration is given the fact that the older person brings years of experience to a position. This experience has cost past employers from $20,000 to $50,000. In many instances, personnel analysts shut their eyes to the experienced older worker and pick out the younger one even though it will cost the company thousands of dollars to train him.

American industry will have to face the fact that as a nation an increased percentage of our population is becoming middle-aged. Industry refuses to consider the hiring of older people and the criterion is that a person over 35 should be consigned to the scrap heap.

Industry screams for qualified workers and yet ignores the fact that experience does not come overnight but as a result of 20 to 30 years of work training. Muscles tend to atrophy if not used. Age has no bearing upon mental development. Thinking does not stop because a person gets older providing the stimulus for using the mind exists. An older person as a rule, can temper intelligent thinking with sound judgment. His years of experience have brought well-rounded development. The relegation of the older worker to obscurity is incongruous when compared to the position of the older worker in European industry. In Europe, he is given deserved recognition, commands respect because of his years and experience, is welcomed instead of ignored.

American industry must revise its thinking. It should make full use of its human resources. All the gadgets and automated machines in the world are useless unless guided by human mental qualities.

Retirement of the worker at 65 should be made voluntary and not arbitrary. Through research and the marvels of medicine the life expectancy has increased. Men and women of 65 and over can still be utilized in production capacities. Firms hiring older workers report that they are more job conscious, their absenteeism rate is less than younger workers and they can better cope with routine and monotonous jobs.

American industry must utilize all the brains and experience exemplified in the older members of our country who can still make tremendous contributions. American industry can profit by dropping the age discrimination.

Samuel M. Paretti
40 Arnold Rd.
Poughkeepsie, N. Y.

. . . supplier's directory

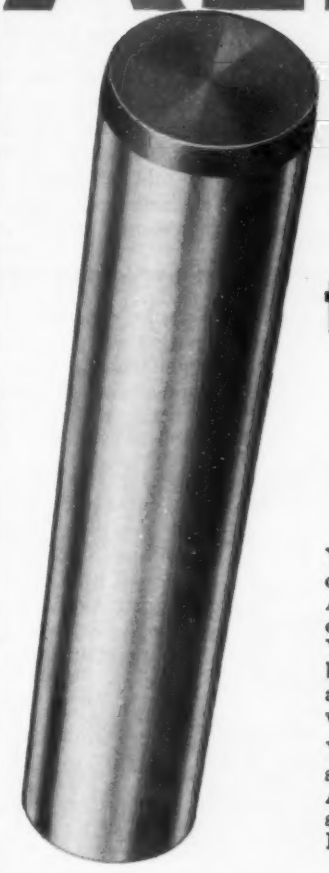
To the Editor:

I have been using my Supplier's Directory for finding local sources for products being used by the plant and find it most useful. It certainly saves time when the suppliers can be called directly instead of the long wait for the home office to forward a request.

A most amusing incident happened the other day while using the book. I was looking for a particular item, which I prefer to have remain anonymous because it would identify my company. Among the names of the suppliers, I found another division of our company was the supplier in the area. So you see, the left hand doesn't know what the right hand is doing at times.

Henry L. Stone
Chief Industrial Engineer
Cleveland, Ohio

ALLEN



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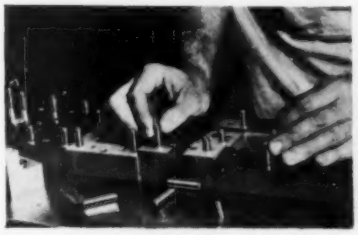
Your ALLEN Industrial Distributor can show you a good many ways to use ALLEN Dowel Pins, in addition to conventional uses in tool and die work. You can use them as economical roller bearings, axles, precision plugs, hinge and wrist pins—and in many other ways.

You can cut the cost of your product substantially, too—because your ALLEN Distributor can supply these strong, accurate, mirror-finished Dowel Pins in standard sizes right from stock.

Made of special Allenoy steel; surface hardened to 62-64 Rockwell C; precision ground to .0001" with micro-inch finish of 6 RMS max. Check your Allen Handbook or Catalog for detailed specs and standard sizes, or write direct for samples and technical information.



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ALLEN MANUFACTURING COMPANY
Hartford 1, Connecticut

ALLEN HEX-SOCKET SCREWS HEAD

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Carl:
This sounds like what we've been looking for. Suggest you enlarge. etc
JC

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Greenlee engineers work with your men at all levels of management, production, and engineering. They gather and exchange information based on broad experience. These contacts accelerate creative thinking . . . one idea stimulates another. Thus cooperative creative-engineering by Greenlee puts a profit-making investment to work in your plant.

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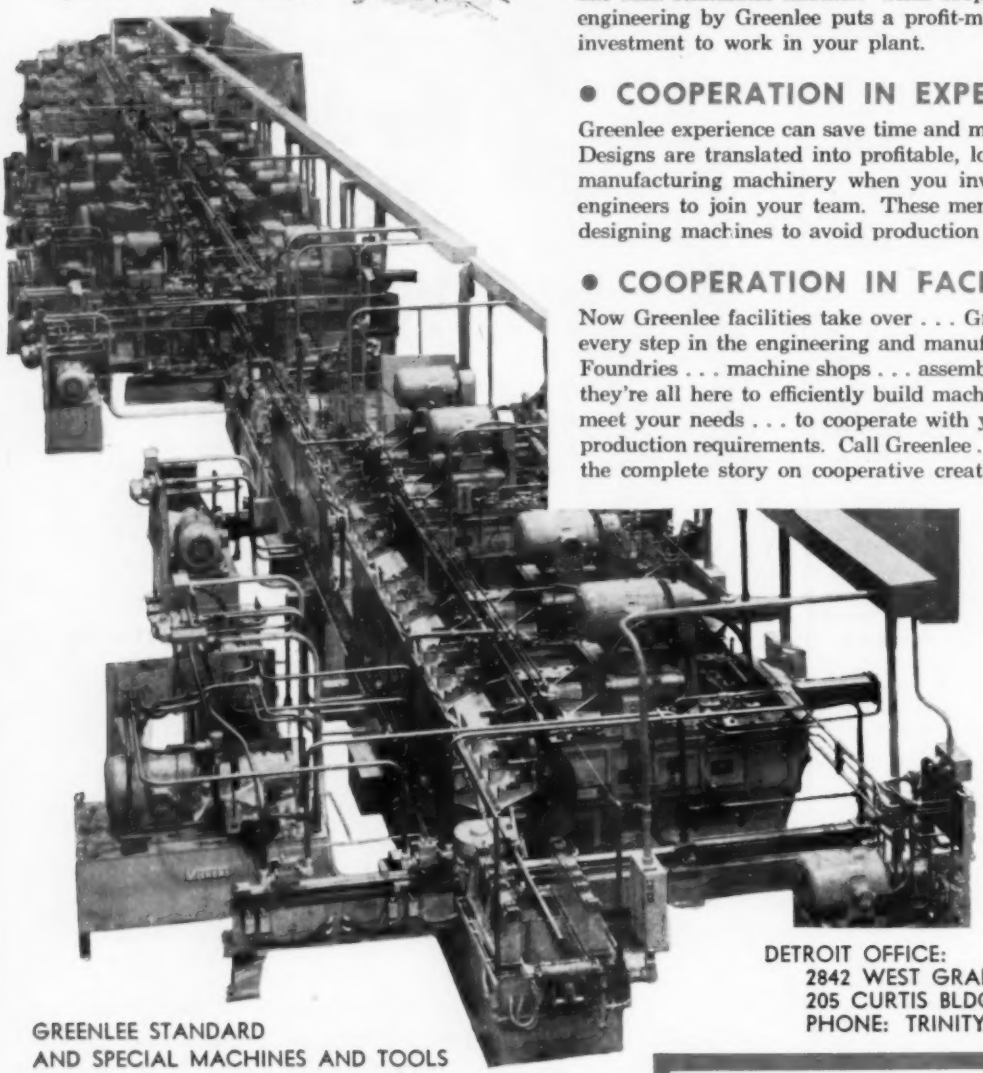
• COOPERATION IN FACILITIES

Now Greenlee facilities take over . . . Greenlee controls every step in the engineering and manufacture of machines. Foundries . . . machine shops . . . assembly floors . . . they're all here to efficiently build machines to meet your needs . . . to cooperate with you in meeting production requirements. Call Greenlee . . . let them give you the complete story on cooperative creative-engineering.



PRODUCTION MACHINERY
GREENLEE

Miss Jones: write for available literature and mail this to Joe Thompson
C.F.

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Machines designed with the future in mind

GREENLEE
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ROCKFORD, ILLINOIS

Joe: These people have a lot of machines in the Detroit area — look them over and let me know your reaction. C.F.

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Field Notes

The Industrial Education Institute of Boston has announced the formation of an overseas subsidiary with headquarters in London, England. The new organization, Industrial Education International, Ltd., was established to provide business and industry with an effective means of exchanging technical information on an international basis. In addition to conducting in-plant indoctrination and training programs for technical specialists and management, IEI will present symposiums, conferences and seminars throughout Europe.

expansions

Union Carbide Nuclear Co. has announced plans for expansion of its tungsten refining plant in Bishop, Calif. The new unit will be capable of producing large commercial quantities of ammonium paratungstate, an important raw material in the manufacture of cemented tungsten carbides and lamp filaments.

V V V

The Dow Chemical Co. has formed a new division for the fabrication of magnesium, aluminum and other metals. The division will be known as The Dow Metals Products Co., and will replace the Dow Magnesium Dept. Production and sales of primary magnesium and magnesium-alloy ingot will continue to be handled by the parent company.

V V V

Lear, Inc. has doubled the size of its operation in Grand Rapids with the completion of a new $5 million manufacturing facility. Specifically designed for the production and assembly of precision aircraft and missile components, the plant will provide Lear with more than 172,000 sq ft of manufacturing space.

V V V

Detroit Harvester Co., a multiline manufacturer of automotive, industrial, agricultural, and consumer products has changed its name to the Dura Corp. The change in name reflects the company's growth and expansion in other fields. With less than 10 percent of its current output in farm machinery and with operations in five states, the company feels that "Detroit Harvester" is a misnomer.

Bellows Co., Valvair Corp. and Sinclair-Collins Valve Corp.—all of Akron and divisions of the International Basic Economy Corp.—will erect a new manufacturing plant in West Memphis, Ark. The three companies manufacture and distribute pneumatic, hydraulic and electrical components for industrial applications.

V V V

Electronics Division of the Gorham Mfg. Co. has added a new investment casting facility as part of its current expansion program. The new foundry equipment will enable the division to produce its own castings for microwave antennas and components in aluminum, magnesium and copper alloys.

V V V

The Dana Corp. has announced the creation of a new division to continue the manufacture of constant-velocity universal joints. To be known as the Con-vel Div., it will be the twelfth such subsidiary operated by Dana.

new activities

General Electric has announced the transfer of its resistance welding control operations from Waynesboro, Va. to Detroit. The company will engineer, manufacture and market all General Electric controls for resistance welding applications. The relocation places the company's welding control business in the center of its heaviest customer concentration and is expected to result in new products for industry.

V V V

Building construction has been completed and installation of close to 500 machine tools and limited pilot production is underway in the new $10 million truck axle plant established jointly in Sao Paulo, Brazil by Rockwell-Standard Corp. and Companhia Brasileira del Material Ferroviario of Sao Paulo. The new company is known as Cobrasma Rockwell Eixos, S/A. With a plant area of 250,000 sq ft, gear production capacity alone will be approximately 30,000 gears per month.

V V V

An International Div., designed to supervise and coordinate the company's expanding overseas activities, has been formed by General Controls Co. Headquartered in the firm's home offices here, the International Div. will handle organizational arrangements, procurement, manufacturing, sales, licensing and distribution of products in all areas outside the continental United States where General Controls has or establishes functioning units.

V V V

Minneapolis-Honeywell Regulator Co. has received a contract to develop and produce an inertial guidance system for Centaur, the first U. S. high energy space vehicle. Centaur will be able to place a 9000-lb payload in a 300 mile orbit or to place a half-ton instrumented package on the moon.

V V V

Giddings & Lewis Machine Tool Co. has announced the formation of a British company named Giddings & Lewis-Fraser, Ltd. The new company has acquired the manufacturing facilities of Douglas Fraser & Sons and will continue to manufacture Fraser designed machine tools as well as the Giddings & Lewis line.

V V V

A new laboratory and engineering service for industry has been announced by the Drillmation Co., Inc. of Centerline, Mich. By the use of a Boremation gun-bore test machine, optimum drilling, boring, reaming and trepanning procedures can be determined for any particular job.

V V V

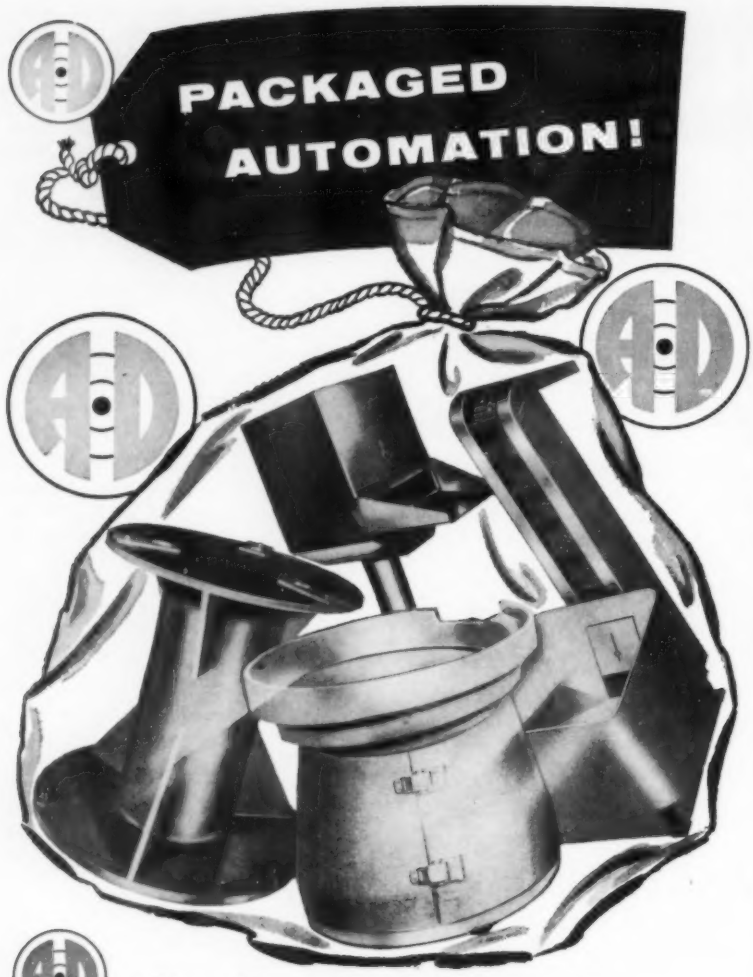
A metallurgical research center designed to expedite the development of high-temperature metals for jet engines, rockets and missiles as well as atomic power generators and other Space Age equipment will be constructed at the Baltimore plant of the Du Pont Co. The installation will contain equipment to forge, extrude, roll, draw and heat treat such refractory metals as niobium, tantalum, titanium, zirconium, tungsten and chromium.

V V V

Rivett Inc., South Bend, has appointed Ray Bobbs Air-Draulics' Inc., Portland, Oregon exclusive distributors of their line of valves, cylinders and power units in the states of Washington and Oregon. Ray Bobbs represents many of the national companies in the fluid power field and specializes in the engineering of hydraulic circuits.

V V V

A hydraulic valve that can be opened or closed within 0.003 sec for applications in rocket launchings, firefighting and nuclear reactors is now being produced by the Bendix-Pacific Div., Bendix Aviation Corp.



Achieve efficient, automatic production, and produce more all along the line, by integrating equipment designed and built by AUTOMATION for automation.

For example, vibratory parts feeders perform more efficiently on an engineered base permitting maximum power transmission. Either the side delivery or the elevating conveyor supply hoppers (with automatic paddle type relay switch to regulate delivery) hold large quantities of parts and are real labor savers. These are just a few advantages that make automation work and pay for itself.

You can depend on the proven talents at AUTOMATION DEVICES, INC.—enlist their help. Write today for the informative bulletin on "Packaged Automation."

PEECO & VFC DIVISIONS... TWO GREAT NAMES IN PARTS FEEDING

AUTOMATION DEVICES INC.
ERIE, PENNSYLVANIA

USE READER SERVICE CARD, CIRCLE 86

Development of a miniature slip-ring assembly has been announced by the Electro Tec Corp. of South Hackensack, N. J. Thirty percent smaller than a similar assembly used in the guidance system of the atomic submarine Nautilus, the miniature assembly demonstrates the speed of obsolescence in the electronics industry.

new companies

A new U. S. and Canada sales and service organization, The Boltmaster Co. has been formed to import Peltzer and Ehler bolt forming machines from Germany. A staff of German trained personnel and complete warehouse facilities are maintained in Cleveland.

v v v

Scully-Jones and Co., Chicago, has announced the formation of the Scully-Anthony Corp. as a research and development subsidiary. The function of the new company will be to increase the parent company's versatility through the development of new products in the electronic and electromechanical fields. Scully-Anthony is located in La Grange, Ill.

association news

Eighteen additional companies have been added to the roster of the National Screw Machine Products Assn. They are: Accurate Screw Products, Ansco Div. of General Aniline & Film Corp.; Ashby Metal Forming Corp.; Burgess-Norton Mfg. Co.; Canadian Acme Screw & Gear, Ltd.; Collison-Goll, Ltd.; Cox Manufacturing Co.; Kaminga Mfg. Co.; Master Screw Products Co.; Micro Engineering Co.; Morrow Screw & Nut Co.; Tooker Mfg. Co.; C. E. Tucker, Inc.; E. G. Vanstone & Son, Ltd.; Wolfe Metal Products Corp.; G. R. Young Screw Machine Products, Ltd.; Y. W. Small Parts, Ltd. and Zenith Screw Products, Ltd.

new facilities

Steel is being fabricated and erection will soon start on the new R. C. Mahon Co. West Coast plant. The 200,000-sq ft manufacturing, and the 10,000-sq ft combined administration and engineering buildings under construction, will be completed before the end of this year.

v v v

The Timken Roller Bearing Co. will build a new railroad bearing pro-

ducing facility in its Columbus Railroad Bearing plant at a cost of 5,250,000. The new unit will duplicate the capacity of the present production line, bringing the total capacity of the Columbus Railroad Bearing plant to over 40,000 car sets a year.

v v v

Completion of construction and occupancy of a new main office and headquarters building in Detroit has been announced by Engineering Service, Inc. of America. The building is designed to provide the ultimate in an efficient, creative atmosphere for its 225-man engineering staff. Special maximum security areas for confidential and classified work have been incorporated into the building.

v v v

American Smelting and Refining Co. has installed new facilities at its Perth Amboy, New Jersey plant, which will increase its capacity to produce high purity indium.

acquisitions

The Leece-Neville Co., Cleveland, has announced that production facilities for its new line of a-c motors will be located in Gainsville, Ga. This line, recently purchased from the O. A. Sutton Co., marks Leece-Neville's first venture into the a-c motor field. Present schedules call for limited production by early autumn.

v v v

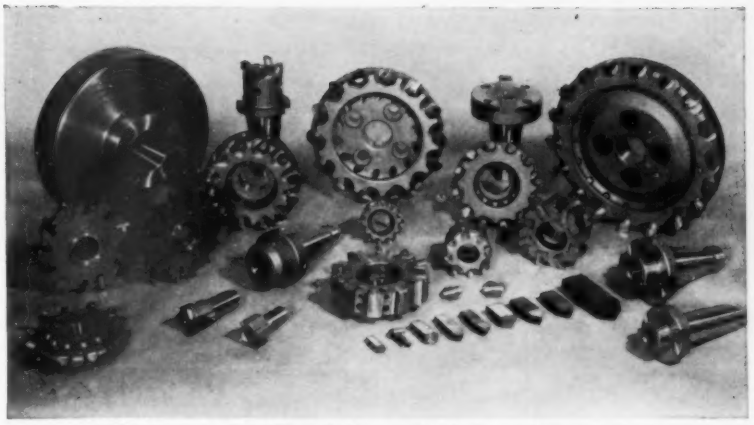
Hevi-Duty Electric Co., a division of Basic Products Corp., has announced its purchase of the Sermax Corp. of Milwaukee. This acquisition is expected to complement the line of industrial ovens that Hevi-Duty acquired with the purchase of the Stroman Furnace and Engineering Co. in September, 1958.

v v v

Lockheed Aircraft Corp. will gain 100 percent ownership of the assets and business of Stavid Engineering, Inc., under details of an agreement signed by officials of the two companies. The Stavid assets and business, together with its personnel, will be transferred to a new wholly-owned Lockheed subsidiary which will use the Stavid name. Stavid business and policy will continue under present Stavid management.

v v v

The Standard Pressed Steel Co. has expanded its operations in the electronics field by acquiring International Electronics Industries, Inc. through an exchange of stock. No changes in man-



Milling Cutters — End Mills — Blades — Boring Tools — Arbors — Flywheels

These Lovejoy Products can help you Cut Costs!

The entire line of Lovejoy Milling Cutters and Accessories is designed to aid you in getting better production at less cost.

If you are not now using Lovejoy products, we invite you to do so at first opportunity.

Lovejoy precision-engineered tools include:

Inserted-tooth milling cutters (face, side, end, slotting and boring) which feature husky, forged steel housings; exclusive Lovejoy "positive-locking" blade assembly; a variety of dozens of models and hundreds of sizes.

Blades: H.S.S., Vasco Supreme and carbide. These are interchangeable over a wide range of housing sizes, and Type "A" face milling blades will fit any standard Lovejoy Type "A" cutter of 4½" to 24" dia. All Lovejoy blades are carried in stock, ready for immediate shipment. Special cutters are a Lovejoy specialty.

The New JOYDEX is a real performer!

Among the startling production reports coming in is a motor frame, rough-milled at 26 cubic inches per minute by an 8" diameter JOYDEX. Finish (with sweep blade) was 63 micro inches. Material was 115 Brinnell boiler plate.

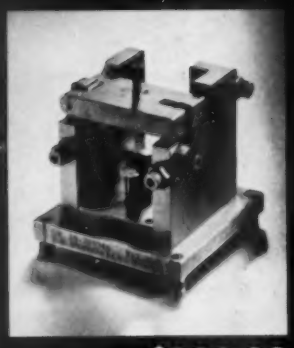
Indexable throw-away blades, plus performance like the above, make the JOYDEX a joy to use—for operator, manager and treasurer. May we send you our latest spec sheet?

Catalogs — include: "Face Mill Catalog No. 31; Side Mill Catalog No. 32; Type "S" Bulletin; Arbor Catalog No. 33; "Speed and Feed" Calculator. Write today for copies desired.

LOVEJOY TOOL COMPANY, INC.
Springfield, Vermont, U.S.A.

USE READER SERVICE CARD, CIRCLE 87

Tooling with tape...



This drill jig: $280.00 This drill jig: $4.20

you can see the profit in point positioning with DIGIMATIC* model 202 Point-Positioning System

Ask us to arrange a demonstration with your parts.
Write for free 12-page booklet, "DIGIMATIC MODEL 202."
Also—movies shown at your shop or plant on request.

The lowest-cost complete point-positioning system for drilling, tapping, reaming, spot facing

*DIGIMATIC IS OUR TRADEMARK

STROMBERG-CARLSON
A DIVISION OF GENERAL DYNAMICS
1494 N. GOODMAN STREET • ROCHESTER 3, NEW YORK

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agement, personnel or operating policies are contemplated at this time.

V V V

Altamil Corp. of El Segundo, Calif. is acquiring all the assets and going business of the Twigg Industries Div. of the Pryor Manufacturing Co. The enlarged Altamil organization is a metalworking subcontractor serving the aircraft and missile industries.

V V V

Robinson Technical Products Inc., manufacturers of specialized equipment used in the aircraft and missile industries, has acquired the High Vacuum Corp. of Hingham, Mass., through an exchange of stock. High Vacuum will continue as a wholly owned subsidiary and will retain its assets.

moves

The machinery building operations of the E. G. Staude Mfg. Co. Inc. will move from St. Paul, Minn. to the Ex-Cell-O plant in Bluffton, Ohio. The Staude Co., a subsidiary of Ex-Cell-O, manufactures paper box making machines and related equipment for packaging.

awards

John Fritz Medal, highest honor of the American Society of Mechanical Engineers, will be awarded this year to Gwilym A. Price, chairman of the board of Westinghouse Electric. Price has been cited for his "inspirational leadership, industrial pioneering and personal initiative in marshalling the creative forces of research and engineering to the cause of developing atomic power for the national defense and for human welfare." The Westinghouse executive will be the first man with a nonengineering background to receive the award. Presentation of the medal will be made at the ASME annual meeting in Atlantic City.

V V V

Worcester Reed Warner Medal for outstanding contributions to engineering literature will be awarded this year to Samuel Glasstone, consutlant to the Los Alamos Scientific Laboratory, Los Alamos, N. M. He is being cited for his "outstanding contribution to permanent engineering literature as exemplified by his book, "Sourcebook on Atomic Energy." Glasstone will receive his award at the annual meeting of ASME in Atlantic City.

Trade Literature

for free booklets and catalogs—use request card, page 173

Electronic Tracer

Simple pencil line sketches of intricate shapes and forms can now be used to guide oxygen shape-cutting machines with a new electronic tracer described in a booklet available from the Linde Co. The booklet illustrates how a unique built-in automatic kerf compensator makes it possible to reproduce one or thousands of complicated metal parts easily and with extreme accuracy from exact size drawings. Form 1287, Linde Co. Div. of Union Carbide Corp., Room 2840, 420 Lexington Ave., New York 17, N. Y. **Circle 301**

Heat Treatment

A 28-page technical booklet entitled, "Modern Principles of Heat Treatment of Steel," describes the derivation and meaning of the TTT diagram and provides fundamental information concerning various heat-treating procedures including step annealing, martempering and austempering. It also includes TTT diagrams for all commonly used grades of SAE tool steels and is liberally illustrated with photomicrographs and charts to clarify the text. Uddeholm Co. of America, Inc., 155 E. 44th St., New York, N. Y. **Circle 302**

Air Power Units

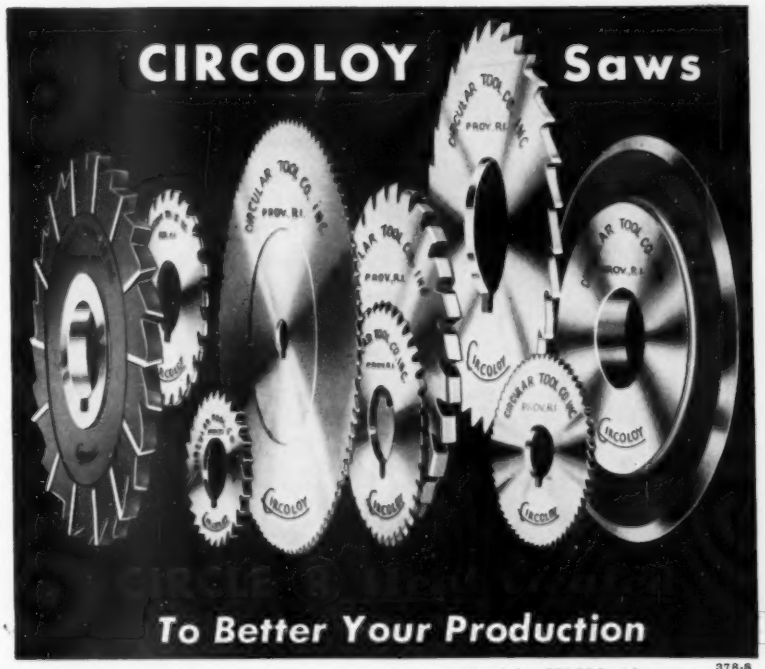
Using color photographs of installations in a variety of industries, a 16-page brochure, "A Panorama of Production Ideas," gives examples of ways in which air motors and other air power work units are used to cut costs, increase productivity per machine and per man-hour, improve quality, reduce scrap and prolong tool life. Also described are a number of services available from the company. Included are idea files, detailed descriptions of how Bellows equipment has been used to convert standard machines or build special purpose equipment to automate an operation or sequence of operations; engineering aids such as wiring diagrams for intricate installations; and educational movies, slides films and demonstrations. The Bellows Co., Akron 9, Ohio. **Circle 303**

Data Processing

A manual entitled "Visible Control for Machine Systems" explains how visible record keeping systems and housing equipment facilitate management decisions and expedite machine operations. KD 854, Remington Rand, Div., Sperry Rand Corp., 315 Fourth Ave., New York 10, N. Y. **Circle 304**

Replacement Formula

The second revised edition of a booklet which describes the Jones & Lamson "Avoidable Costs" Replacement Formula, a method for appraising the productivity of machine tools and similar capital equipment, is available. Jones & Lamson Machine Co., Springfield, Vt. **Circle 305**



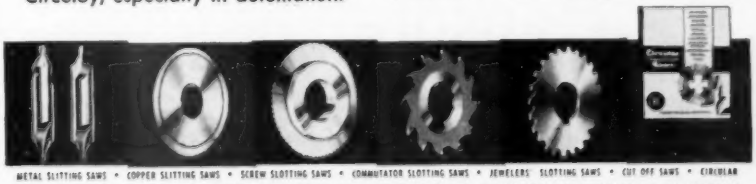
378-S

CIRCLE R exclusive heat treating renders Circoloy Saws shock-resistant, non-brittle. They greatly outperform HSS in service life, longer production runs, superior cutting, lower cost. Ask your Circle R Specialist when to use Circoloy, especially in automation.

Consult these CIRCLE R *Specialists . . .*

BURBANK — Production Mach. Sales Inc.
CHICAGO — Donald Robertson & Co.
CLEVELAND — Production Tool Co.
DAYTON — J. R. Kuntz Company
DETROIT — A. B. Spruce
MACKENSACK — The Eaton Company
INDIANAPOLIS — Walter F. Greene & Assoc.
MILWAUKEE — Ford Tool Co.
MONTREAL — Humphrey B. Walton
NEW YORK CITY — J. E. Cranmore (Export)
PHILADELPHIA — General Tool Sales Co.
PHOENIX — D-Eugenia Tool Center
PITTSBURGH — Ralph Esposito & Company
PROVIDENCE — Fred J. McMillen
ROCHESTER — James D. Horne
ST. LOUIS — B. C. MacDonald & Co.
WESTBURY, L. I. — The Eaton Company

CIRCULAR TOOL CO., INC.
PROVIDENCE 5, RHODE ISLAND
Specialists in Circular Cutting Tools Since 1923



METAL SLITTING SAWS • COPPER SLITTING SAWS • SCREW SLOTTING SAWS • COMMUTATOR SLOTTING SAWS • JEWELERS' SLOTTING SAWS • CUT OFF SAWS • CIRCULAR SAWS & ROTARY SHEAR BLADES • CIRCOLOY STEEL SAWS • SOLID & TIPPED TUNGSTEN CARBIDE SAWS • COMBINED DRILLS & COUNTERSINKS • CENTER REAMERS

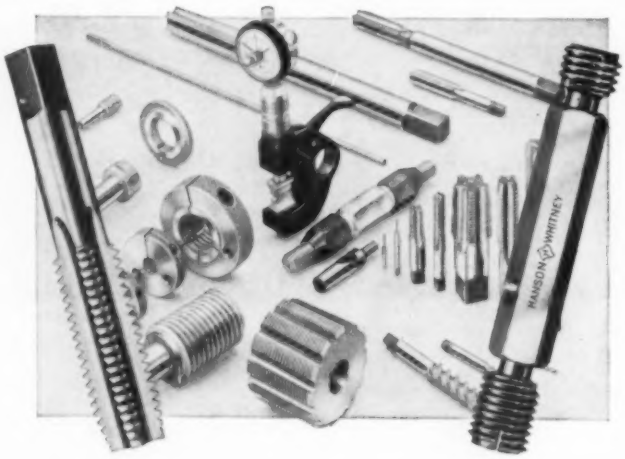
USE READER SERVICE CARD, CIRCLE 89

New:

Hanson-Whitney's new production techniques give you *consistent* quality cutting edges with *"free-cutting action"* for increased productivity. These advances in Hanson-Whitney standard cutting tools mean longer tool life—uniform size and less binding. And you protect your threading investment from start to finish, with Hanson-Whitney's *related* line of standard Thread Gages—keeps your profit dollars up, where they ought to be.

Complete and Related "STANDARDS"

Your Hanson-Whitney distributor puts a *complete and related* line of standard *"free-cutting action"* tools and gages at your finger tips. He is your threading specialist backed up by Hanson-Whitney's forty years of thread engineering and experience. Call him now.



Hanson-Whitney
COMPANY

204B BARTHOLOMEW AVE., HARTFORD, CONN.

STANDARD: Taps • Thread Gages • Cutters • Fine Pitch Gear Hobs

USE READER SERVICE CARD, CIRCLE 90

Radiation Pyrometers, Detectors

A newly revised catalog offers a complete description of the theory and fundamentals of radiation pyrometry as well as the function, construction and application of Radiamatic pyrometers. A section on how to choose the proper radiation detector is also included. Instruments that can be used with this type of temperature sensing element are described in detail. Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa. **Circle 306**

Mechanical Toolholders

An 18-page catalog, MTI-5, presents a new line of mechanical toolholders and throwaway inserts. Firth Sterling Inc., 3113 Forbes Ave., Pittsburgh 30, Pa. **Circle 307**

Pressure Pickup

Bulletin 1620 describes Type 4-326 pressure pickup. Capable of absolute and gage measurement to 10,000 psi, the pickup has a provision for external adjustment of temperature compensation, sensitivity and bridge balance. The bulletin furnishes a description of the pickup and has sections on the design features and specifications. Also included are a schematic drawing and a wiring diagram. Bulletin 1620, Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif. **Circle 308**

Laminating Resin

A new laminating bulletin outlining the major uses of expoxy resins to aircraft, automotive, missile, structural, model-making and maintenance fields includes a table of properties where complete physicals are reported, not only on the laminated structures, but also on the resin per se. Basic data on epoxy laminates are included. Furane Plastics Inc., 4516 Brazil St., Los Angeles 39, Calif. **Circle 309**

Steels

Universal-Cyclops Steel Corp. has published a new technical data brochure covering Unimach I and Unimach II high-strength, high-temperature steels, for critical structural applications in airborne vehicles. Technical data includes information on the heat treatment and physical mechanical properties of the steels and graphs illustrating tensile and yield strengths, temperature properties and stress-rupture curves.

Universal-Cyclops Steel Corp., Station St., Bridgeville, Pa. **Circle 310**

Horsepower Nomogram

A dual nomogram for horsepower, torque and rpm applicable to fractional horsepower motors and transmissions, gives two scales each for torque and for horsepower. Issued in data sheet form, it includes rpm scale from 0.5 to 500 rpm; torques to 300 in.-lb on one scale and 600 ft-lb on the other; and horsepower scales for corresponding product values of torque and rpm. "Horsepower Nomogram for Motors and Transmission," Merkle-Korff Gear Co., 213 N. Morgan, Chicago 7, Ill. **Circle 311**

Replacement

Purpose of a replacement analysis manual is to provide an industrial tool which can be used to better appraise machinery replacement from a sound investment viewpoint. The manual includes the Replacement Analysis form, a discussion of the pros and cons of replacement policies in general, an explanation of the terms used in the form, and actual case histories of replacements made by customers. The Heald Machine Co., Worcester 6, Mass. **Circle 312**

Atomizing Nozzle

Bulletin No. 184 describes the Calco no-drip atomizing nozzle No. 2000, its characteristics and application specifications. Drawing No. 184 provides a standard parts list for the nozzle. Columbus Automatic Lubrication Co., 81 E. State St., Columbus 15, Ohio. **Circle 313**

Boring Bars

A new system of listing and pricing the individual elements of a boring bar enables users of Davis catalog D-520 to secure custom-arranged bars at standard prices. General-purpose and production bars for either line or stub boring operations are described. Heat-treated and flame-hardened bars, with a choice of standard shanks, are priced according to length and diameter. Standard bar diameters run from 1¼ through 7 in. in increments of ¼ in., with recommended maximum length ranging from 48 to 204 in., depending on diameter. Slots for block tooling, straight-through or angular cutter tooling, and Davis Super-Mike flycutter tooling assemblies are priced individually. Keyways of different sizes are priced per inch of length. Stub boring tool sets and micrometer-adjustable offset stub boring heads are listed. Giddings & Lewis Machine Tool Co., Davis Div., Fond du Lac, Wis. **Circle 314**

Grinding Wheels

A four-page color brochure describing cylindrical grinding wheels is off the press. It explains the desired characteristics of cylindrical wheels and describes the abrasives and bonds employed for cylindrical cutting operations. Photographs of various types of cylindrical wheels, cylindrical wheel test records, and wheel recommendations for cutting a wide range of metals are included. Macklin Co., Jackson, Mich. **Circle 315**

Metal Parts

A four-page bulletin treating the process of producing sintered metal parts, their physical characteristics, mechanical properties, economies and applications is available from Burgess-Norton Mfg. Co., Geneva, Ill. **Circle 316**

Thread Rolling

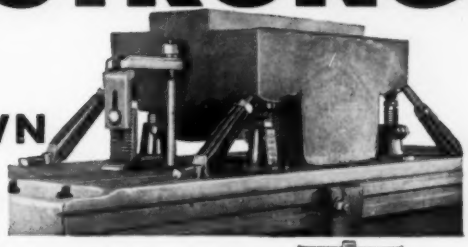
Bulletin E-101 pertains to the recently announced, thread rolling machine, the Lan-Nu-Rol. It describes the machines specifications and capacities and includes design and operating features. Landis Machine Co., Waynesboro, Pa. **Circle 317**

Bar Automatics

Catalog MSB-59 illustrates and describes a line of multiple spindle-bar automatics. It lists engineering design and construction features of all models of 4, 6 and 8 spindle machines. Illustrations of standard and special independently operated attachments, general specifications, and standard equipment for all models are included. The National Acme Co., 170 E. 131st St., Cleveland 8, Ohio. **Circle 318**

ARMSTRONG

SET-UP *and* HOLD-DOWN TOOLS



ARMSTRONG Set-up and Hold-down Tools reduce setting-up time—keep men and machines producing. Designed for use on planers, drill presses, milling machines, etc., they hold work securely and rigidly, and thereby reduce spoilage and prevent costly accidents.

Your local Armstrong Distributor carries ARMSTRONG Set-up and Hold-down Tools in stock in sizes for every operation. Stop haphazard setting-up methods. Provide each of your machines with a full complement of ARMSTRONG Set-up and Hold-down Tools.

Write for Circular

ARMSTRONG BROS. TOOL CO.

5257 W. Armstrong Ave., Chicago 46, Ill.

PLANER JACKS

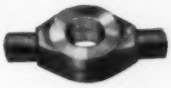
NON-SKID JACKS

STEP BLOCK

T-SLOT CLAMP

UNIVERSAL CLAMP

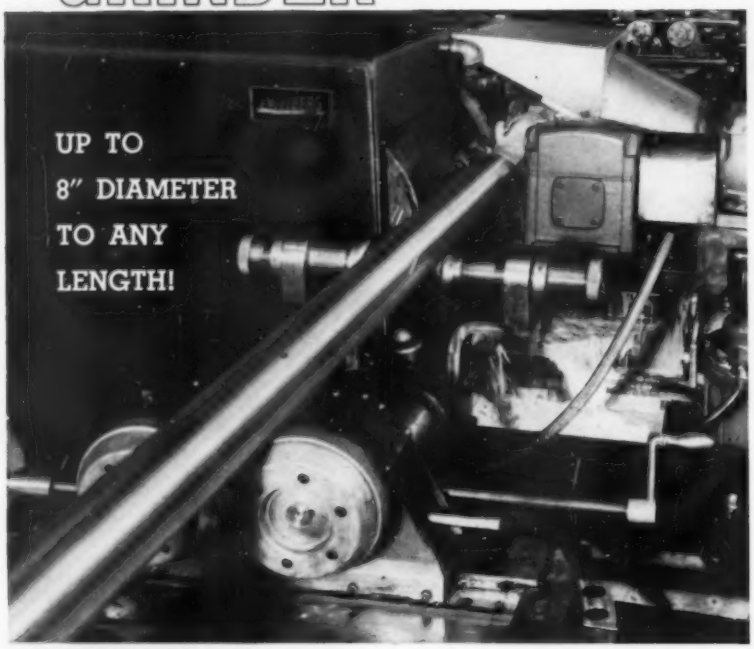
T-SLOT BOLTS AND NUTS



STRAP CLAMPS

USE READER SERVICE CARD, CIRCLE 91

NEW HEAVY-DUTY CENTERLESS GRINDER



ENGELBERG 8132-HD

removes 3 lbs. metal per minute!

Loaded with "firsts," the Engelberg 8132-HD now makes possible exceptionally heavy single pass stock removal, extremely fine finishes, close tolerances on any rod or tube stock.

New large workpiece capacity—precision grinds and finishes any length, takes diameters from 1" to 8".

New powered outboard support system—main power unit controls synchronized "slave" units for variable through feed rates.

New automatic reverse feed—microswitch controls automatically change helix angle of outboard support power units and regulating wheel to reverse feed direction for multiple through feed passes; eliminates intermediate material handling.

New highs in production—Ex: 416 stainless steel bars 5.060" diameter, 20' length; removal .018" stock per pass at feed rate of 70" per minute. 1020 steel tubes 6¾" diameter, 10' length; removal .015" per pass at feed rate of 3' per minute.

Write for bulletin: **New Savings With Centerless Belt Grinding**

SUNDSTRAND-ENGELBERG

***Precision* Abrasive Belt Grinders**

SUNDSTRAND **SUNDSTRAND MACHINE TOOL**

Division of SUNDSTRAND CORPORATION

BELVIDERE, ILLINOIS

USE READER SERVICE CARD, CIRCLE 92

Metal Cleaning

Over 100 types of equipment and techniques for the cleaning and preparation of metal surfaces are presented in a 32-page handbook. Both the basic factors in metal cleaning and specific methods to meet a variety of cleaning problems, including degreasing, decarbonizing, washing, Bonderizing, stripping, drying, blackening, phosphatizing, rust proofing, pickling, and coating are covered. Various sections cover the analyzing of cleaning problems and the subsequent selection of the correct chemical method and equipment for the individual job. Equipment Div., Magnus Chemical Co., Inc., Det. TE, Garwood, N. J. **Circle 319**

Welding Equipment

A new 24-page catalog includes complete specifications and ordering information on gasoline and Diesel engine driven welders, engine driven welder-power combination units, electric motor driven arc welders, rectifier type welders, transformer type welders, combination transformer-rectifier type welders, a-c and d-c inert-gas-shielded arc welders, and a complete line of automatic and semiautomatic welding equipment. The catalog also describes a line of induction heating equipment, pipe thawing equipment, and a power source for cutting and gouging. Catalog EW-209, Hobart Brothers Co., Troy, Ohio. **Circle 320**

Compressed Air Fundamentals

Ingersoll-Rand Co. has just published a booklet entitled "Compressed Air Fundamentals." It is designed to facilitate the selection of a small "packaged" air compressor for either automotive or industrial application. The booklet also basically describes compressed air, how it is compressed, single and two-stage compressors, piston displacement, actual delivery, unloading of compressors, regulation and types of control used. Other material included is information on compressor oils, pipe sizes, wire sizes and terminology and definitions used in connection with the compression of air. This booklet contains tabular and chart information on cubic feet of air required to operate a variety of pneumatic equipment, average and continuous air supply tables, cylinder diameters required to develop power to overcome indicated loads, volumes of compressed air required per stroke to operate various size air cylinders, and a chart on ratios of compression and tables on flow of air through orifices. Form 1548, Ingersoll-Rand Co., 11 Broadway, New York, N. Y. **Circle 321**

Gaertner Toolmakers' Microscope used to measure typical piece part. Co-ordinate range 4" x 2".

Precise measurement to 0.0001" and 1 min. of arc

Gaertner Toolmakers' Microscope

Here is a reliable, easy-to-use microscope for precise measurement of piece parts, tools, dies, thread gages, templates, jigs, fixtures, etc. Ideally suited for making a wide variety of precision measurements and is especially valuable in reducing rejects in production work.

With the Gaertner Toolmakers' Microscope you make direct, non-destructive measurements — no contact, no distortion, images are sharp and clear. It is a basic measuring instrument for inspection depts., gage labs, tool and die and model shops, industrial and research labs.

The Gaertner Toolmakers' Microscope has been proven in use by U. S. Government Gage Laboratories, and by prime contractors and their subcontractors. With all parties using the same measuring instrument, inspection procedures are co-ordinated and disagreements and rejects minimized.

Features that help you get
HIGH SETTING AND REPEATING ACCURACY

- Low, compact built-in rotary stage reads to 1 minute of arc throughout 360° range.
- Minimum overhang of stages.
- Full 2" precision-lapped lead screws with correction device.
- Straightforward, direct, uncomplicated optical system.

Features that assure you of
EASY, CONVENIENT OPERATION

- Independently rotatable cross hairs in protractor ocular speed up measurements, simplify measuring procedure.
- Convenient location of ocular eyepieces for ease of reading.
- Built-in transformer and plugs for all illuminators.

Modifications and accessories to
MEET YOUR EXACT REQUIREMENTS

- Thread and radius templates, camera and spotting attachments, fine motion focus, variable magnification available.
- If you have a special measuring problem, our staff of representatives will be happy to consult with you. The service and engineering facilities of the manufacturer are always immediately available to help you.

Write for Bulletin 147-56

Designed and manufactured by

The Gaertner Scientific Corporation

Telephone: BUckingham 1-5335

USE READER SERVICE CARD, CIRCLE 93

PURCHASING HANDBOOK—*Editor in Chief, George W. Aljian. Published by McGraw-Hill Book Co., 330 W. 42nd St., N. Y. 36, N. Y. Price $15. 1392 pages.*

All of the data about the various phases of purchasing department operations including organization, management and procedures has been combined into one authoritive handbook. These areas of activity are covered by a group of experts in the field. Information covers all the data necessary for persons responsible for purchasing to obtain the best job by getting the right commodity at the right price and having it at the right place at the right time.

Facts, principles, methods and data cover the purchasing routine, rating of venders, buying economically, controlling inventory, preparing contracts and forms. The book will be useful to anyone buying for governmental, institutional and other nonprofit organizations, as well as for business and industry.

MOTION AND TIME STUDY, FOURTH EDITION —*By Ralph M. Barnes. Published by John Wiley & Sons, Inc., 440 Fourth Ave., N. Y. 16, N. Y. Price $9.25. 670 pages.*

Basic principals are underlined in successful applications of motion and time study as well as by illustrations and practical examples to supplement the applications in this revised edition. Additional chapters have been included on motion study and mechanization in automation, mechanized time study, electronic data processing, as well as studies of the various systems of motion-time data. In addition, topics include work sampling, evaluation and control factors other than labor and multifactor wage incentive plans.

New material is covered on developments of the industrial use of pulse rate as an index of physical activity. The

Plastic Steel® saved $180

Within a matter of 2 hours this holding fixture was poured and ready for use at General Electric, and the cost — about $20.00 instead of the original $200.00. Whether you need jigs, fixtures, metal forming dies, molds, models, foundry patterns and core boxes or other special tools, PLASTIC STEEL® and other Devcon products will produce a precision form and save hundreds of dollars and hours.

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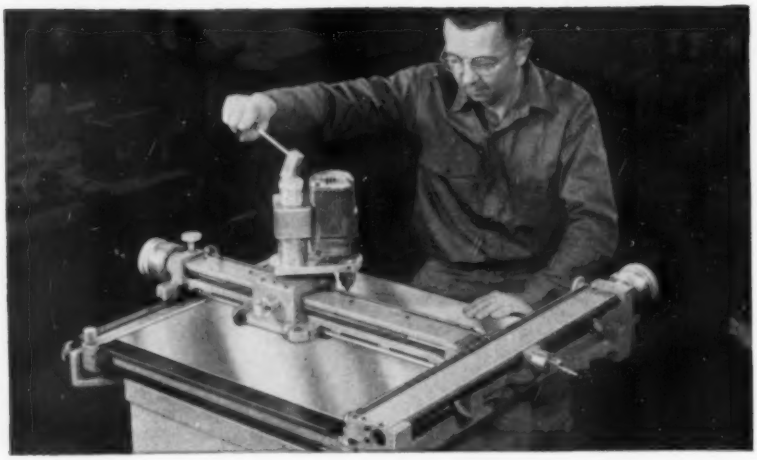
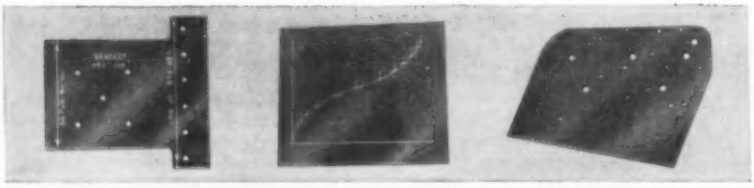
template making time
cut in half...



THE NEW **STRIPPIT**
FLEX-O-DRILL

- **DRILLS, REAMS, SCRIBES, CENTER PUNCHES** to ± 0.002" WITHOUT base line drawing or height gauge layout!
- **EASY, ACCURATE POSITIONING**—quickly set to any reference point and to nearest 0.100" by adjustable steel tapes reading in both directions from zero. Micrometric gauges then bring settings to nearest 0.001". No optical scanning device needed.
- **LASTING ACCURACY!** Table is an actual ground surface plate. Bridge assembly is of heavy, accurately machined castings. Lead screws are precision ground and engaged only during micrometric gauge settings to minimize wear. All parts are corrosion-resistant. Bearings are protected against dust and chips by felt shields. Drill motor is heavy-duty industrial type.
- **¼" CAPACITY** in mild steel — stock up to 24" width, any length.
- **ALSO A PROVEN MONEY-SAVER** on pilot runs, low unit production.



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time study section has been enlarged by material on statistical procedures in time study and information on auditing of methods, time standards and wage incentive plans. Most of the common systems of motion-time data are outlined and four systems are described in detail. Complete tables of motion-time data for each of the detailed systems form a major portion of these sections.

ENGINEERING MANUAL—*Prepared by a staff of specialists. Edited by John H. Perry and Robert H. Perry. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., N. Y. 36, N. Y. Price $9.50. 680 pages.*

This revised manual contains a concise reference to the most commonly used data and methods in the major engineering fields. Mathematical tables and physical and chemical data essential to all engineering are provided in three separate sections. Specialized tables, graphs, charts and formulas as well as other practical aids are presented under the appropriate engineering section heading.

EFFECT OF SURFACE ON THE BEHAVIOR OF METALS—*Published by the Philosophical Library, Inc., 15 E. 40th St., N. Y. 15, N. Y. Price $10. 105 pages.*

This book is based on a series of lectures delivered at the Institution of Metallurgists refresher course in 1957. It contains various papers on the methods of preparation, examination of surfaces, influence of surface treatments by the chemical behaviour of metals, relationship between surface condition, frictional resistance and wear, and influence of surface on physical properties of metals.

PROGRAMMING BUSINESS COMPUTERS—*By Daniel D. McCracken, Harold Weiss and Tsai-Hwa Lee. Published by John Wiley & Sons, Inc., 440 4th Ave., N. Y. 16, N. Y. Price $10.25. 253 pages.*

Details involved in actually working with digital computers are discussed in this book in a clear and logical form. Points that are especially troublesome to beginners are treated in the first chapters. A sound understanding of programming is built by means of a lucid presentation of computer basic fundamentals. The coverage is on a practical level and is based on a mythical computer that contains elements from a number of different models currently on the market. While dealing with business applications, the fundamentals should be applicable to many situations found in the use of computers for numerical control.

technical shorts

Jet Cooling For Annealing

Jet cooling, a major innovation in annealing furnace design, developed by the General Electric Company's Industrial Heating Dept., now permits increased furnace output and as much as 30 percent reduction in floor space required by the annealing section of a typical continuous annealing and cleaning line. This design for faster cooling of light-gage strip employs a number of self-contained, independent units, each with its own 60-cycle, motor-driven blower and heat exchanger. These units force high-velocity cooled gases against, and perpendicular to, each strip surface. Each of the jet units is readily accessible, providing for simple maintenance and ease of operation. When the furnace is designed for additional capacity in the future, cooling facilities can be extended by installation of additional jet units and rolls.

The primary feature of this furnace design is the marked increase in heat transfer now possible. This increase permits cooling to temperatures lower than any other known dry cooling methods.

Jet cooling is effective in the temperature range of 900 to 100F for furnaces operating at speeds strip up to 2000 fpm at outputs up to 60 tons per hour. Eight passes in the new annealing furnace can do the same work as 30 passes with conventional equipment.

Initial designs were tested in a special furnace with convection currents up to 120 mph.

* * *

Creep Properties of Plastics

Creep properties are usually thought of in connection with the study of metals. However, they have important applications in the evaluation of viscoelastic materials such as rubber or plastics. It was necessary to determine creep properties during a Stanford Research Institute project for Wright Air Development Center dealing with changes in solid rocket propellants during storing and aging. As a result an improved method for creep measurement was designed.

Conventional devices usually consist of a system whereby weights are suspended from a sample of the material. The downward movement of these weights is observed at specific time intervals until a significant curve of deformation can be obtained. Limitations to older methods include the fact that observations are made visually. Errors are possible because of the minute measurements involved.

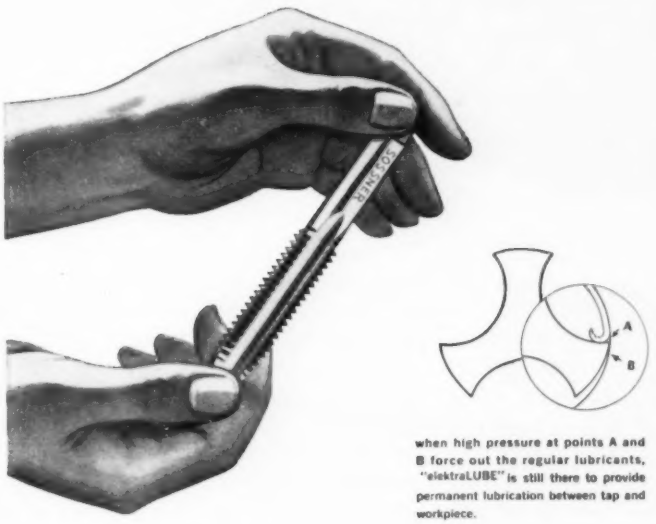
The SRI method eliminates these drawbacks by the fact that measurements are made continuously and automatically by means of a strip chart recorder. Consequently the device saves a great deal of observation time and is accurate to 0.005 inch.

Fiberglass Curtain Eliminates Hazards

Fiberglass curtains are being used in the metalworking industry to protect workers from flying chips and sparks. One such curtain, used at Allis-Chalmers in Milwaukee, is 14 feet wide and extends to a height of 30 feet. The curtain is raised and lowered by an air motor that is synchronized with the travel of the head on an Ingersoll boring bar. Chips and sparks generated while machining a 13-foot diam turbine housing are deflected harmlessly to a conveyor and the chips are moved by the conveyor into tote boxes. This wide-spreading protection not only guards tool ways, spindles, rams, cross-rails and so on, but also prevents hot chips from being a shop hazard.

Teflon, neoprene and silicones are also used for protective curtains. The curtains are made by A&A Mfg. Co., Inc., Milwaukee, Wis.

the surface of this "elektraLUBE"® tap is it's own super lubricant



when high pressure at points A and B force out the regular lubricants, "elektraLUBE" is still there to provide permanent lubrication between tap and workpiece.

"elektraLUBE"® Taps are an exclusive SOSSNER development solving the problems of loading and galling by providing supplementary SELF-LUBRICATION.

An "elektraLUBE" Tap has a ductile metal lubricant permanently bonded to its threads and cutting surfaces.

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The new Bellows Lubri-Air® Control Unit

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● This new Lubri-Air Control Unit, made by The Bellows Co., and sold and serviced by Bellows and Valvair Corporation Field Engineers, is a major break through to the problem of supplying clean, dry, pressure-regulated and properly lubricated air to pneumatic equipment.

The Bellows Lubri-Air Control Unit, once set to match the needs of the equipment it serves, automatically removes dirt and moisture from the air stream, maintains a constant down stream pressure regardless of fluctuations in supply pressure or in cfm requirements, and feeds a correct amount of misted oil to the air stream regardless of variations in the air flow rate.

Bellows Lubri-Air Control Units assure continuous top working efficiency as well as maximum long life with minimum maintenance from air-powered equipment.

Available for immediate delivery in the ¼", ⅜" and ½" sizes. ¾" and 1" sizes shortly.

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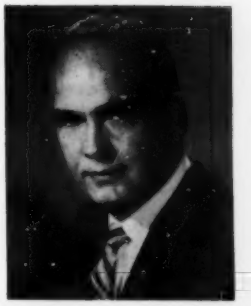
Heinz Hanau, left, has been named director of engineering and research of Industrial Tectonics, Inc., Western Div., Compton, Calif. He was educated in Sweden and the U. S. He has been associated with Ranger Aircraft Engines and with New Departure, Div. of General Motors.

C. Thorpe Thompson, right, formerly president of The Cleveland Instrument Co., has been named director, vice president and general manager of the Sheffield Corp. He is also a group executive, vice president and director of Bendix Aviation Corp., of which Sheffield is a subsidiary.



Men at Work

DR. NICHOLAS A. WEIL has been named director of mechanical engineering research at Armour Research Foundation, Illinois Institute of Technology. He will direct areas of research and development in stress and structural analysis, automation, materials engineering and dynamics and vibrations.

LAWRENCE G. BLACKMON has been appointed manager of the Phoenix Works of Capital Foundry Div., National Malleable and Steel Castings Co. He replaces B. J. AAMODT, who has been assigned special duties. ROBERT D. EVERETT has been promoted to manager of the Sharon Works, part of the Transportation Products Div., and EDWARD O. SPAHR will replace Everett as general superintendent at Sharon.

The Holley Medal, bestowed only for an act of engineering genius resulting in public benefit, will be awarded to COLONEL MAURICE J. FLETCHER, director of the Army Prosthetics Research Laboratory, Walter Reed Army Medical Center, Washington, D. C., for his design of artificial limbs credited with giving amputees a new freedom of movement. Fletcher will receive the medal from The American Society of Mechanical Engineers on November 30 at the Society's Annual Meeting.

ALEXANDER F. BREWER, formerly head of Hughes Aircraft Co. missile electronics section, has been appointed technical director of Hughes Products Group. He will provide technical advice on new and existing company projects.

FREDERICK H. HUNTOON has been named factory manager for Bendix Filter Div., Bendix Aviation Corp. He will be in charge of all manufacturing operations. Huntoon has been associated with Brockway Motor Trucks, the Modine Mfg. Co., and the Pullman Standard Car and Mfg. Co.

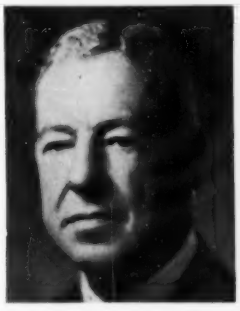
ROY B. WILLIAMS has been appointed West Coast plant manager for American Machine Div., United States Chemical Milling Corp., Culver City, Calif. He previously served as assistant to the vice president of manufacturing at American Bosch Arma Corp.

Appointment of EARL S. EVANS as assistant chief engineer of the Steam Turbine Dept. has been announced by Allis-Chalmers, Wisconsin, Wis.

After a year's study of advanced management techniques and procedures under a Sloan fellowship at Massachusetts Institute of Technology, H. Follett Hodgkins, Jr., has returned to his position as vice president of Rollway Bearing Co., Inc., Syracuse, N. Y. He was one of 37 executives selected for the course.

The Waltham Precision Instrument Co. has elected Andrew C. Bayle to the post of vice president, engineering. Bayle has had 19 years of experience in the electromechanical field, particularly in servomechanisms and gyroscopes. He is a recipient of the Naval Ordnance Development Award for work on the "Bat" missile.

John T. Bachman, of Youngstown, Ohio, has been appointed a vice president of the Jones & Laughlin Steel Corp., Stainless and Strip Div. Bachman will be in charge of carbon and stainless strip sales; Kenilworth (N. J.) and Los Angeles warehouse sales; and sales activities of the Metallon plant, Canfield, Ohio.



Byron K. Hartman of Philadelphia has been appointed executive vice president and general manager of Syntron Co., Homer City, Pa., a subsidiary of the Link-Belt Co. Hartman, who has been sales manager of Link-Belt's Colmar, Pa. plant, has been with the parent company since 1937.

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A. "Ace" Vetter newly appointed manager of overseas operations for The Cross Co. of Detroit, is in Europe to begin operations for Cross' new German plant. Vetter has been associated with the machine tool industry since coming to the U. S. in 1931. He is a member of the ASTE chapter No. 1.

Milton J. Kuhn, a charter member of the ASTE Fond du Lac chapter No. 4, has been named western district manager of Futurmill Inc. His headquarters will be in the Los Angeles area. Kuhn was formerly with the Davis Boring Tool Div. of the Giddings and Lewis Machine Tool Co.

Peter H. Fratangele has been appointed chief engineer of E. W. Bliss Co., Mackintosh-Hemphill Div., Pittsburgh, Pa. He joined the company in 1955 as chief draftsman and, in 1956, was named assistant chief engineer.

who's meeting and where

Oct. 4-17. HUNGARIAN SCIENTIFIC SOCIETY FOR MECHANICAL ENGINEERING. International Festival of Mechanical Engineering, Scientific and Technical Films, Budapest, Hungary.

Oct. 5-10. SOCIETY OF AUTOMOTIVE ENGINEERS. National Aeronautic Meeting, Aircraft Manufacturing Forum and Aircraft Engineering Display, The Ambassador, Los Angeles. Contact society offices at 485 Lexington Ave., New York 17, N. Y. for more information.

Oct. 6-7. ELECTRONICS INDUSTRIES ASSOCIATION. Conference on Value Analysis, University of Pennsylvania. More information can be obtained from association headquarters, 650 Salmon Tower, 11 W. 42nd St., New York 36, N. Y.

Oct. 7. SOCIETY OF PLASTICS ENGINEERS, INC. Regional Technical Conference on Vinyl Plastics, Cleveland Engineering Society Bldg., 3100 Chester Ave., Cleveland. Obtain additional information from Jack R. Pecktal, Eastman Chemical Products, 13212 Shaker Square, Cleveland 20, Ohio.

Oct. 7-9. GRAY IRON FOUNDERS SOCIETY. Annual Meeting, Fairmount Hotel, San Francisco, Calif. Contact W. M. Caldwell, Assistant Secretary, Gray Iron Founders Society, National City-E 6th Bldg., Cleveland 14, Ohio, for more information.

Oct. 11-16. AMERICAN SOCIETY FOR TESTING MATERIALS. Pacific Area National Meeting, Sheraton-Palace, San Francisco, Calif.

Oct. 12-14. NATIONAL ELECTRONICS CONFERENCE, Hotel Sherman, Chicago, Ill. NEC, 84 E. Randolph, Chicago, Ill.

Oct. 13-14. SOCIETY OF PLASTICS ENGINEERS, INC. Southern California Section, National Technical Conference, Progress in Plastics Engineering. Ambassador Hotel, Los Angeles, Calif.

Oct. 14-16. AMERICAN MANAGEMENT ASSOCIATION. Order Picking Seminar on how to reduce costs of order picking, packing and warehousing. Hotel Astor, New York, N. Y.

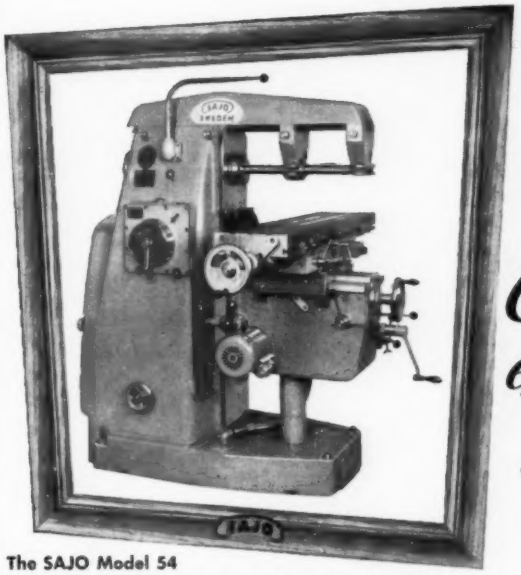
Oct. 16. SOCIETY OF PLASTICS ENGINEERS, INC. Buffalo Section, National Technical Conference, Plastics Finishing. Hotel Niagara, Niagara Falls, N. Y.

Oct. 19-23. NATIONAL SAFETY COUNCIL. Annual Congress and Exposition. Industrial Safety sessions at Conrad Hilton, Congress, Sheraton, Morrison and La Salle hotels. Further information available from R. L. Forney, Secretary, National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

Oct. 20-22. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. ASME-ASLE Lubrication Conference, Sheraton-McAlpin Hotel, New York, N. Y. For further information contact Meetings Dept., ASME, 29 West 39th St., New York 18, N. Y.

Oct. 20-22. AMERICAN STANDARDS ASSOCIATION. National Conference on Standards, Sheraton-Cadillac Hotel, Detroit, Mich.

Oct. 21-23. AMERICAN SOCIETY OF BODY ENGINEERS. Annual Technical Conven-



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The SAJO Model 54
No. 2 ALL-GEARED Milling, Machine Plain or Universal

is an outstanding example of Swedish craftsmanship and fine quality materials, combined in a modern design.

Capable of continuous dependable service under the most severe conditions and guaranteeing maintenance of accuracy to tenths, the SAJO Model 54 Millers meet all requirements for:

POWER..... 7½ HP motor drive to spindle (5 HP optional).
1½ HP table feed and rapid traverse motor.

RANGE..... 16 spindle speeds 39-1500 RPM (optional 31-1200 RPM).
12 table feeds 11/16" to 25"/min. longitudinal and cross.
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Power rapid traverse 96"/min. longitudinal and cross. 48"/min. vertical.
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ACCURACY .... Handscraped sliding surfaces, Spindle (#50 NMT taper) mounted in four precision SKF bearings ensuring constant smooth operation and fine finish.

SIMPLICITY ..... Single adjustable START-STOP-BRAKE lever, Dial selection of speeds and feeds.

Priced well below levels of comparable top grade millers.

Prompt delivery. Full selection of accessories available.

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Wilson "Rockwell" Hardness Testers can help make your products better, stronger, longer lasting. They give reliable results on the production line, in laboratories, in tool rooms, and in inspection departments. They're as easy to use as a center punch, as durable as a machine tool, as sensitive and accurate as a precision balance. That's why Wilson "Rockwell" is recognized as the world's standard of hardness testing accuracy.

Wilson "Brale" Diamond Penetrators give Perfect Readings

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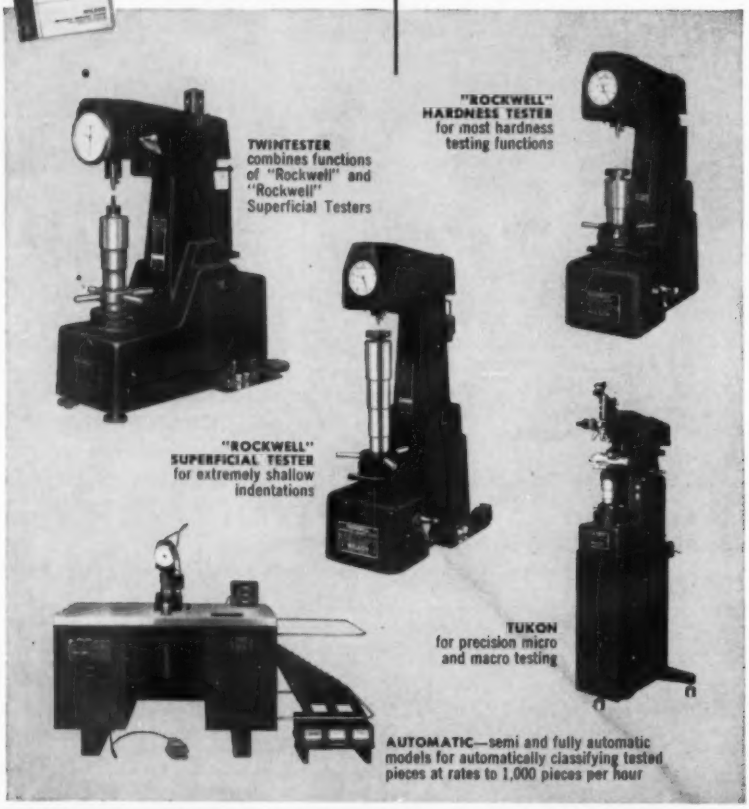
Write for Catalog RT-58. It gives complete details on the full line of Wilson hardness testing equipment.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combines functions of "Rockwell" and "Rockwell" Superficial Testers
"ROCKWELL" HARDNESS TESTER
for most hardness testing functions
"ROCKWELL" SUPERFICIAL TESTER
for extremely shallow indentations
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for precision micro and macro testing
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tion, Rackham Memorial Bldg., 100 Farnsworth Ave., Detroit, Mich.

Oct. 22-23. ILLINOIS INSTITUTE OF TECHNOLOGY, ARMOUR RESEARCH FOUNDATION. Annual National Conference on Industrial Hydraulics, Hotel Sherman, Chicago, Ill. For further information contact R. D. Meade, Illinois Institute of Technology, 3300 Federal St., Chicago 16, Ill.

Oct. 22-23. GALVANIZERS COMMITTEE. Forty-first meeting, St. Francis Hotel, Canton, Ohio.

Oct. 22-25. AMERICAN SOCIETY OF INDUSTRIAL DESIGNERS. Annual Meeting, Grove Park Inn, Asheville, N. C.

Oct. 27-28. MATERIAL HANDLING INSTITUTE, INC. Traveling Clinic, Rensselaer Polytechnique Institute, Hartford, Conn. Second day, Vendome Hotel, Boston, Mass.

Oct. 28-29. ARMOUR RESEARCH FOUNDATION, ILLINOIS INSTITUTE OF TECHNOLOGY. Annual Computer Applications Symposium, Morrison Hotel, Chicago, Ill. Address inquiries to M. J. Jans, Conference Secretary, Armour Research Foundation, 10 W 35th St., Chicago 16, Ill.

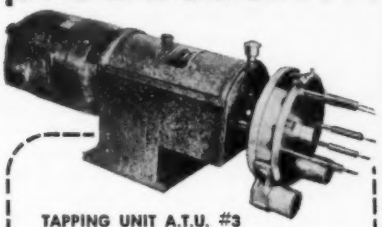
Nov. 2-4. ATOMIC INDUSTRIAL FORUM. Annual Conference, Sheraton-Park Hotel, Washington, D. C. For further information contact D. J. Scherer, Manager, Public Information, Atomic Forum, 3 East 54th St., New York 22, N. Y.

Nov. 2-6. AMERICAN SOCIETY FOR METALS. National Metal Exposition & Congress, International Amphitheatre, Chicago, Ill. Further information available from Chester L. Wells, Exposition Manager, Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

Nov. 4-8. NATIONAL TOOL & DIE MANUFACTURERS ASSOCIATION. Annual Convention for members, Statler Hotel, New York, N. Y.

Nov. 9-11. STEEL FOUNDERS SOCIETY OF AMERICA. Fourteenth Annual Technical and Operating Conference. Carter Hotel, Cleveland, Ohio.

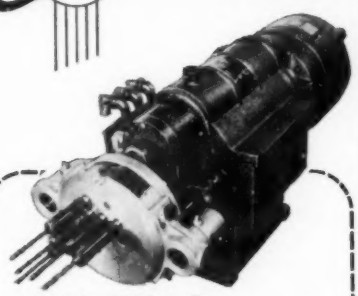
The Tap and Drill Team for your hole production...



TAPPING UNIT A.T.U. #3

Completely self-contained all-electric lead screw precision unit. Quickly interchangeable for fast single or multiple spindle head operation. With forward and reverse electro-magnetic clutches and variable torque control.

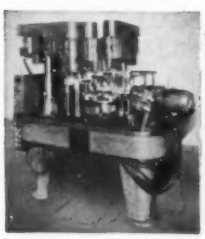
Ettco-Emrick **TAP & DRILL TWINS**



DRILLING UNIT D.U. #2

Completely self-contained precision unit with powerful air feed and hydraulic control. Quickly interchangeable for fast single or multiple spindle head operation.

Used singly or in combination they offer the flexibility and adaptability to meet modern drilling and tapping requirements. When combined with Ettco-Emrick multiple spindle heads they'll set new standards of precision, speed and economy.



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Building the Twins into high production special machines is simple, because all units are electrically controlled and all components are standardized equipment. We can supply the assembly complete with tooling — or you can do it in your own plant.

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Radioactive Drawing Tools

Radioactive drawing tools have been used by W. Lueg and P. Funke for measuring wear under various conditions. Their report is published in *Stahl und Eisen*, Vol. 79 (1959), No. 14. under the title: "Verschleiss-Messungen beim Ziehen von Stabstahl mit radioaktivem Zieh werkzeung."

The effect of different surface treatments and lubricants was studied. The results proved that dry drawing soap protects the tools best. Practical tests confirmed this finding. Commercially available lubricants were included in the tests. It was also found that very small layers of rust—hardly visible to the eye—increase wear substantially.

Chip Formation and Surface Finish in Peripheral Milling

Chip formation in peripheral milling has been investigated by H. Phillip, using a simulating process by planing the work surface at a slope and producing a wedge-shaped chip. His article appears in *Werkstatt und Betrieb*, Vol. 92. (1959), No. 7, p. 447-455. The article title is: "Ueber die Spanbildung und die Werkstueck-Oberflaeche beim Walzenfräsen."

The device for producing wedge-shaped chips could be so adjusted that either "thin-thick" chips or "thick-thin" chips or "uniform" chips could be made. The thin-thick simulates chip formation of conventional "upmilling" operations, while the thick-thin chip simulates chip formation of "down-milling" operations. The uniform chip simulates planing. The cut could be quickly interrupted at any point during chip formation.

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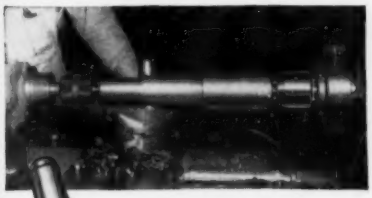

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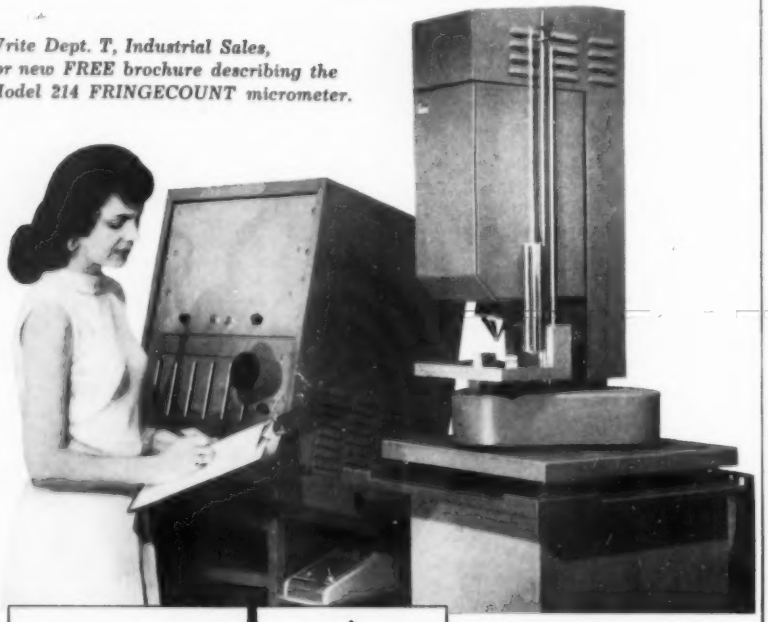

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Built-up edge was studied in this way. Phillip concludes that the built-up material is not uniformly distributed along the cutting edge, but resembles a mountain range with peaks and valleys. In turning operations, on the other hand, the built-up edge is of more uniform height.

The author introduces the concept of the base-length (Fussbreite) of the built-up edge, a dimension measured in the direction of chip flow. The base length of the built-up edge increases with the feed per tooth. A correlation between unit cutting force and base length could not be established, however. Built-up edge, as correctly stated by H. Phillip, is undesirable because of the detrimental effect on surface finish, although some tool engineers still think that a built-up edge protects the cutting edge. This is actually not the case in view of the periodic formation and destruction of the built-up edge associated with the tearing out of tool particles.

Metal Drawing Machinery

Development of metal drawing machinery is well described in a *Stahl und Eisen* article: "Grundformen der Ziehbaenke und deren Hilfseinrichtungen," by F. Grah.

This article will be informative for any tool engineers not familiar with such machinery. The author describes in detail the various stages of drawing benches going back to the designs of 1884. Modern machines which feature automatic return of the tools and automatic discharge of workpieces are also discussed. Handling time is considerably reduced with such machines. Tube drawing machines are likewise discussed, as are mandrels and pushers.

Cooling of Machine Tools

The ever increasing accuracy required of modern machine tools is greatly affected by the temperatures and thermal expansion or thermal deformation of machine tool elements. E. V. Nagel has published an article dealing with the cooling of the oil used at various places in machine tools. His article is in *Technischen Zentral Blatt fuer praktische Metallbearbeitung*, Vol. 53, No. 3, June 1959, p. 93-96, under the title "Fragen der Oelkuehlung an Genauigkeitsmaschinen."

The author deals particularly with refrigerating devices for circulating oil, mentioning a number of machine tools that have been equipped with such devices. Among them are a thread grind-

ing machine made by H. Lindner (Germany); a jig borer made by S.I.P. (Switzerland); and a similar machine made by Dixi (Switzerland).

As an example of the temperature effect, Nagel cites the case of a thread grinding machine. The temperature rise of workpiece and leadscrew causes an expansion exceeding the tolerance of accuracy. In the case of a thread of 40 in. length, an increase in temperature of 1 deg C produced an expansion of 0.00096 in. while it was necessary that the cumulative pitch error not exceed 0.00080 in.

The author describes—in detail—the refrigeration units which hold the oil temperature constant in the machine.

Face Milling Clearance Angles

It is customary to grind face milling cutters with clearance angles of 6 to 8 deg, particularly when carbide inserts are employed.

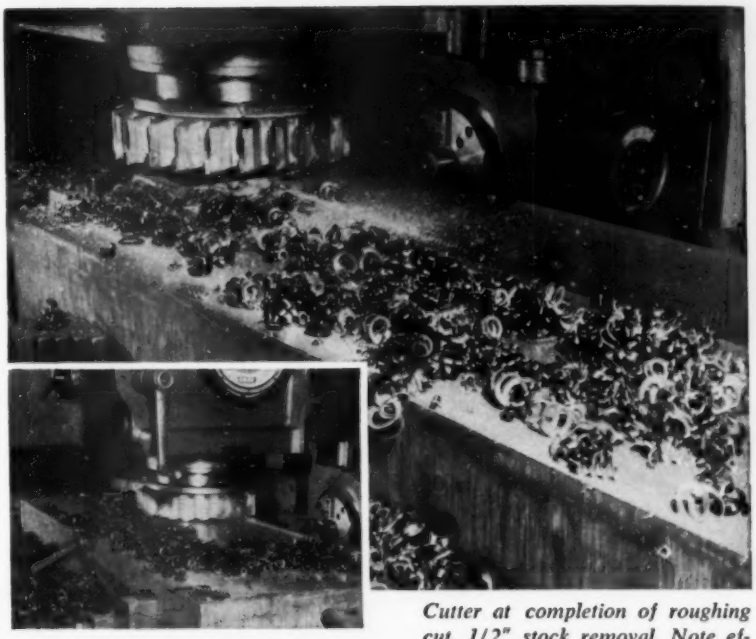
No substantial research has been carried out to prove that these angles are the best. Russian reports to the effect that larger clearance angles have improved production resulted in a survey being made—and tests run—by the tool committee of A.D.B., a subdivision of V.D.I. (Verein Deutscher Ingenieure). An anonymous report on this investigation is published in *Werkstatts Technik*, under the title "Fräsen mit vergroessertem Freiwinkel" (Milling with Increased Clearance Angle).

It is stated that changes in tool geometry are the most promising way to improve cutting performance if the "best" cutting speed is being used and cannot be modified.

Tests were run at various plants, producing automobile motors, sewing machines, machine tools and heavy machinery, under supervision of the A.D.B. tool committee. Twenty-four different items were recorded in each of the participating plants, including type of machine, details of cutters used, width of cut and analysis of work material. A blank form listing variables appears with the article.

An elaborate system for evaluation of the tests was developed. The effect of the machine and of the cutting conditions was relatively small. Quality of the workpiece material had a greater effect. A clearance angle of 14 deg was found to be the limit, while those between 11 and 13 deg proved to be the most desirable values. The effect of true rake was likewise recorded (equivalent to the radial rake). Best results were obtained with radial rakes between 0 and 5 deg, combined with axial rakes of 5 to 7 deg.

Several German manufacturers of face milling cutters have started investigations of their own and are now favoring clearance angles of 14 deg.



1/16" finish cut. Note fine surface finish, a result of true running, flywheel cutting action.

Cutter at completion of roughing cut. 1/2" stock removal. Note efficient, uniform chip formation.

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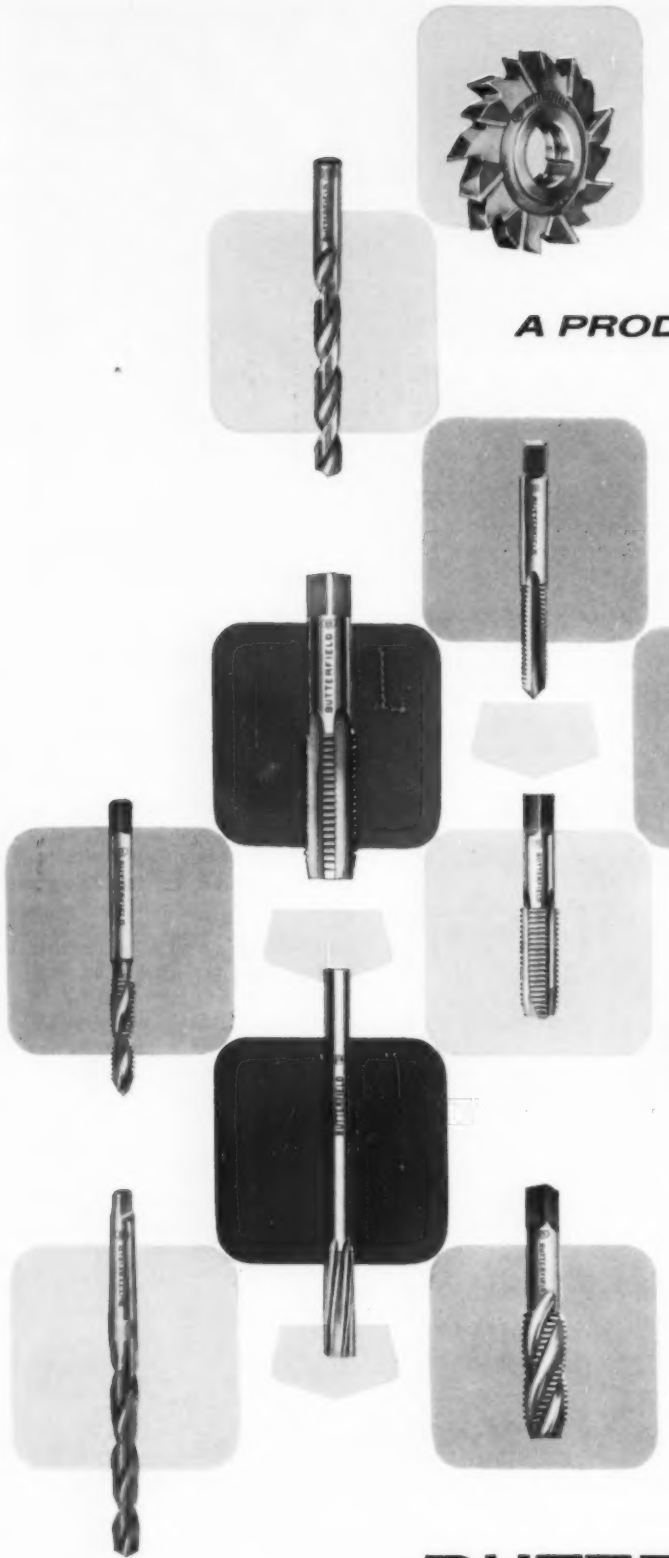

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Metallizing in the Process Industries

Tech Digests

By Walter B. Meyer
President
St. Louis Metallizing Co.
St. Louis, Mo.

RAW MATERIALS used in the metallizing process consist of metal in wire, in powder form, or ceramics in powder or stick form, oxygen, fuel gas, and compressed air. The material to be deposited is fed at a uniform rate of speed, determined by its melting point, through the spraying unit. As it emerges from the tip of the unit, the material is subjected to the heat of an oxy-fuel gas flame. This converts the solid material into a molten or semimolten liquid. This molten material is then atomized into finely divided molten spheroids which are projected at a very rapid rate of speed onto a suitably prepared surface, where they again solidify as shown in Fig. 1. As the molten particles are projected an oxide envelope forms around each droplet. When these molten particles strike the surface, they are flattened into a ragged, saucer-shaped particle. When these droplets strike the object that is being coated the outside envelope is ruptured and the flattened particles build up, one upon the other, like snowflakes in a snow bank.

This method of depositing metal results in a laminar deposit which has characteristics very similar to cast structures. The cohesion of particle to particle is largely by oxide cementation, while the adhesion of sprayed metal to base material is essentially by mechanical means. It is important to know that metallized deposits are ten times stronger parallel to the laminations than at right angles to them. Therefore, it is apparent that most sprayed metal coatings have a low tensile strength, little elasticity, but great resistance to compression.

The fact that any material obtainable in wire or powder form can be sprayed, immediately implies that many alloys can be deposited for resistance to corrosion. This is true, up to a point, for the chemical changes resulting from passing a solid material through a flame and then atomizing it are rather negligible.

The use of sprayed metals in rebuilding worn machine elements spans more than a quarter of a century. This can be accomplished with metals that are harder, or have greater corrosion resistance than did the metal from which the shaft was originally made, or with metals that have more desirable properties.

In such applications the porous nature of sprayed metals is a distinct advantage because the retention of the lubricating oil in the pores of the metal increases the wearing characteristics.

The use of stainless steels, copper alloys, and nickel alloys for building up machine parts is quite common. These materials are usually applied in such thicknesses that the porosity through the total mass is eliminated.

Sprayed-metal coatings, with but a few exceptions are attached to the base material by mechanical means. Therefore, the process does not generate enough heat to cause warpage or a

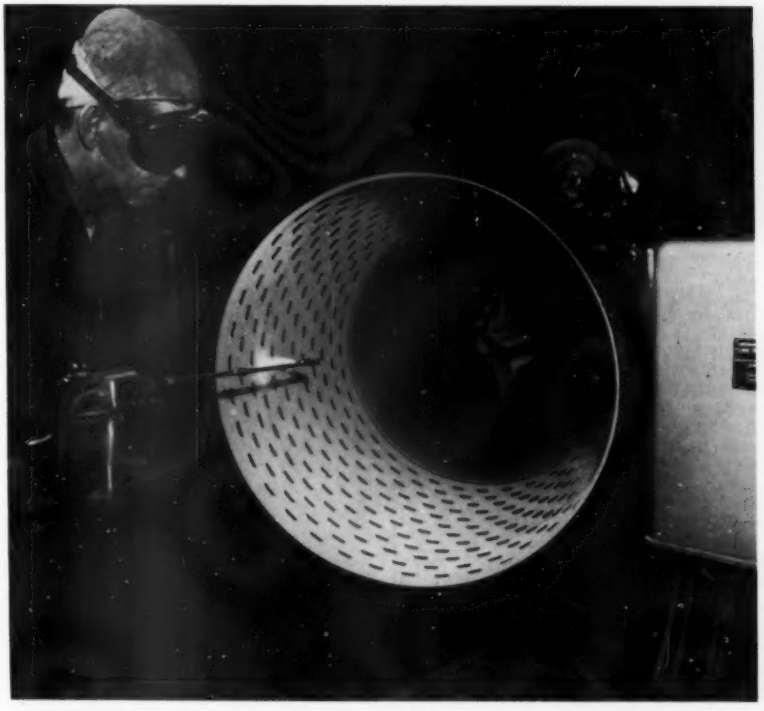

Fig. 1. Spraying guided missile combustion chamber with alumina. The dead white color of the coating reflects the heat of the firing as well as forming an insulation barrier. Zirconium oxide is also used to resist oxidation.

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Fig. 2. Three metallizing units depositing type 420 stainless steel on circumference of a cast-iron flaker drum. The stainless coated drum is corrosion-resistant and gives longer wear than an uncoated vessel in service.

change in the crystal structure of the metals. The perfection of techniques evolved over many years of experience, improvements in equipment and the development of new and better spraying alloys has resulted in increased bond strengths, more dense coatings, and reductions in costs. In metallizing, the cleanliness is of supreme importance.

The rebuilding of a cast-iron flaker drum operating in a starch slurry is shown in Fig. 2. This drum had become badly worn from the action of the "doctor" blade and was rapidly losing wall thickness. Rebuilt with Type 420 stainless steel (0.13 to 0.14 chromium, 0.30 to 0.40 carbon) four years ago, this flaker drum is still giving excellent service.

A 36-in. diam x 8 ft long flaker drum, used in a chemical plant, Fig. 3, had become badly worn by the action of the "doctor" blade. This drum was rebuilt 2½ years ago and is in excellent condition after constant use.

When metals are arranged in the order of their potential in the galvanic series, it will be observed that all metals appearing above iron and steel will afford protection by slowly sacrificing themselves. The flow of current is from the metal appearing higher in the series to any metal appearing below it. Moreover, the greater the separation between the two metals in the galvanic series, the greater will be the flow of current and the greater will be the rate of sacrifice of the higher material. So, for the

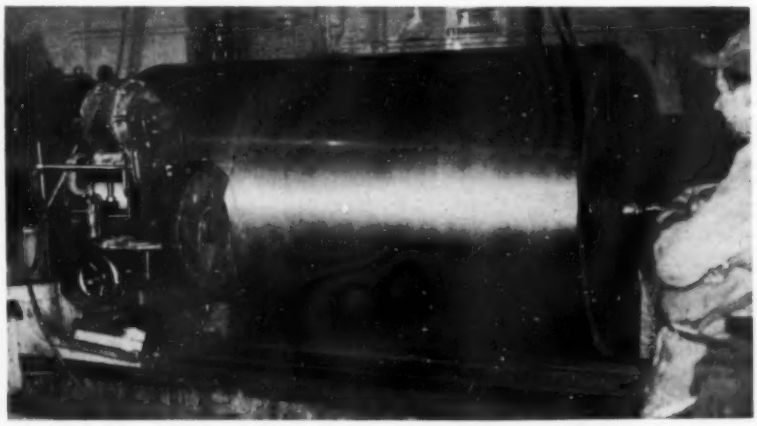

Fig. 3. After metal spraying with stainless steel, cast-iron flaker drum is ground smooth on the outside surface. After two and one-half years the drum is still in use and in excellent condition after constant operation.

past 20 to 30 years, metallized coatings of zinc and aluminum have been giving, and are still giving, excellent protection to a variety of structures in many parts of the world.

The preparation of large flat areas for the reception of corrosion-resistant coatings is usually accomplished by sandblasting with the use of a very sharp angular abrasive projected through a pressure-type blasting machine. A material not suitable for use as an abrasive in preparation for a sprayed-metal coating, is round river sand. Such materials do not cut dovetails and interstices into which the droplets of molten metal can be keyed.

Recently, procedures for impregnating the porous structures of sprayed deposits with various plastic formulations have been developed. These formulations can be polyvinyl chlorides, epoxies, catalyzed phenols and phenolepons, and heat-cured phenols. These materials are introduced into the pores of the sprayed metal, displacing the air, and resulting in an imprevious barrier.

When these impregnating procedures are used with sprayed metals that are cathodic to iron or steel (stainless steels, nickel, monel, and so on), they should be carefully tested prior to use. Sprayed-metal thicknesses, impregnating procedures, and the choice of plastic materials are all extremely critical. The application of plastic materials to sprayed metals that are anodic to steel (zinc and aluminum) is in nowise so critical and is quite easily accomplished.

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At present there are seven "flame ceramic" coatings; namely, alumina, zirconia, iron-titanium oxide-alumina, iron titanium oxide, titania, mullite, and

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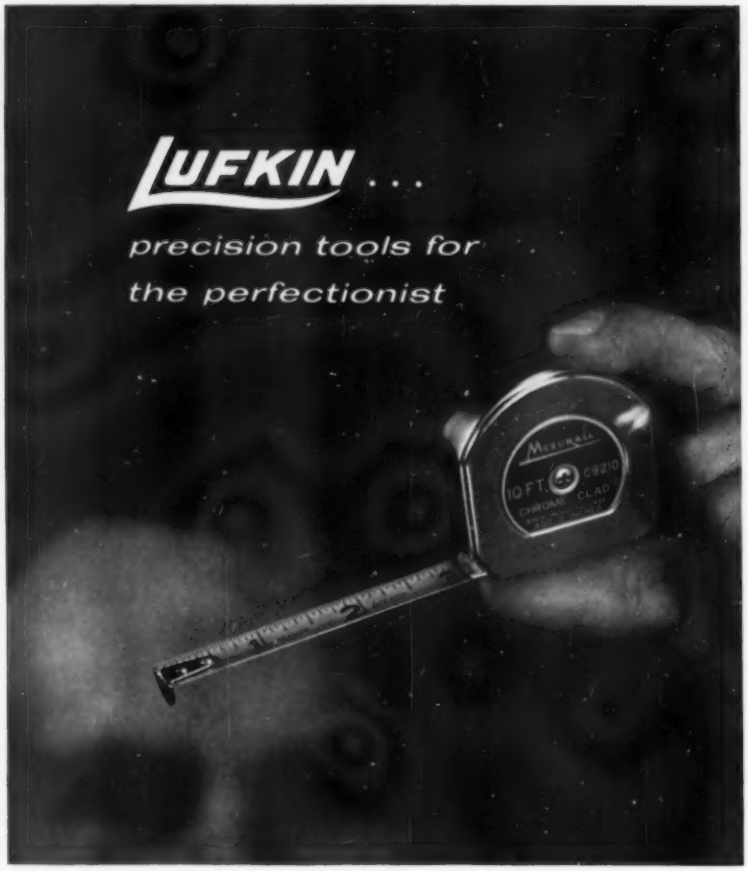

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a rare earth-oxide mixture. Various others are in the developmental stages.

In general, the coatings are crystalline and porous. The adherence and the thermal-shock resistance of these materials are due to their porous nature. They can be flexed to the yield point of the base metal without spalling.

Components of the combustion chambers of some of the guided missiles are coated with either aluminum oxide or zirconium oxide to resist the oxidation of firing temperatures. Fig. 1 illustrates the application of an aluminum-oxide coating to a component of one such combustion chamber.

The dead-white color of the aluminum oxide coating reflects the heat of the firing, as well as forms an insulation barrier.

The zirconia coating presents a nonwettable surface on contact with molten metal. This nonwetting property and high thermal insulation is desirable for many metallurgical applications.

Based on a paper contributed by the Process Industries Div., and presented at the Semi-annual Meeting of the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

▼ ▼ ▼

Maintaining Control Systems

By Charles Suchanek

Superintendent of Maintenance
Republic Aviation Corp.
Farmingdale, N. Y.

A log should be kept on every piece of equipment, giving information such as scheduled shutdown for repairs and unscheduled shutdown due to failures, whether mechanical or electrical. For example, in the case of a particular fuse blowing without any apparent overload, the log will indicate the need for investigation if reoccurrence is frequent. The log should show parts replaced, amount of downtime, and any other information pertinent to a case history of a particular piece of equipment. All this information is helpful in computing operating costs, and in determining overhaul or machine retirement. Preventive maintenance programs include routine inspections that enable planning whereby a machine in need of repair parts replacement need not be taken out of production. The work can be done in slack production time or during vacation periods, and parts can be made or ordered to be on hand in advance. Routine inspections, whose frequency can be determined by past experience or manufac-

turer's recommendations, give a maintenance supervisor an over-all picture as to the condition of all equipment and eliminate the possibility of any deterioration going unchecked and resulting in a breakdown.

Preventive maintenance on numerical control is far more involved than on other types of machines. Besides the hydraulic system, there are the tape recorder and its associate amplifiers; optical checks and adjustments on one type of system; magnetic reading heads, pinch rollers and pressure pads, and preamplifiers in another type of system. Also there is calibration of logic inputs, balancing of system and feed rates, and numerous others. Routine preventive maintenance of numerical control systems requires approximately 16 hours per month for an electronics technician and machine repair man working as a team.

Based on a paper presented at the Plant Maintenance & Engineering Conference held by Clapp & Poliak, Inc., New York.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

Structural Changes in Irradiated Plastics Films

By Charles F. Bersch
Robert R. Stromberg

and

Bernard G. Achhammer

Plastics Section
National Bureau of Standards
Washington, D. C.

The use of high-energy radiation for preservation of food has received considerable attention in recent years. If foods are packaged prior to irradiation, the packaging materials will be subject to the radiation. Plastics films, because of physical properties such as flexibility and transparency, are being evaluated for use in this application. In addition to the effects of radiation on the physical properties of the plastics films, e.g., tensile strength, it is important to determine chemical changes as a result of irradiation of the film by itself and in contact with food systems. The purpose of this paper is to report some results obtained in a study of the relationship between chemical structure of plastics films and radiation stability.

The relative stabilities to be expected from plastics of different chemical structures on exposure to ionizing radiation are known as a result of investigations such as those by Sisman and Bopp and Ballantine. Their investigations were conducted under more severe conditions than the materials used for packaging radiation-sterilized foods might be expected to endure. Consequently, several materials which might be excluded on the basis of the above results were included because it was expected that they might show satisfactory stability at 5.6 or 0.93 megards and might be especially suitable because of some attractive feature such as cost, ease of handling, sealing properties or outstanding physical properties. Cellulose materials were not included in this investigation because considerable information has been published on the radiation susceptibility of these materials and further study did not seem to be justified.

To a first approximation, the stability of a plastic is related to the total quantity of gaseous products evolved and to detected changes in its chemical structure. If the films studied here are ranked on the basis of these criteria, polystyrene is the most promising material; rubber hydrochloride and the polymonoclorotrifluoroethylenes are next, fol-

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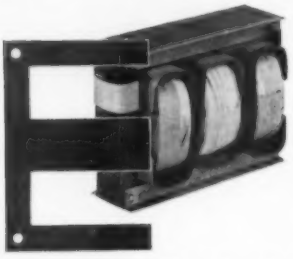

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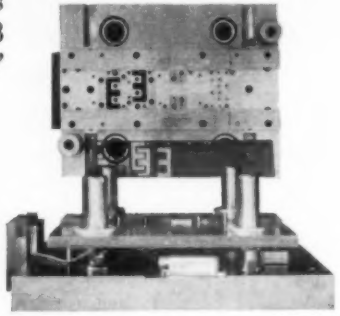

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lowed by poly (ethylene terephthalate). The poly (vinylidene chlorides), which follow next, are considerably less stable than the materials listed above, but are considerably more stable than the remaining group, which includes the polyethylene-coated polyester, high-density polyethylene and low-density polyethylene, in that order.

However, the criteria listed above are not sufficient for the end application. The types and concentrations of the products and the sites and conditions of their development are also important. For example, if the amount of hydrogen produced by the polyethylenes is subtracted from each polyethylene total, it will be found that, on the basis of total products evolved, the polyethylenes rank immediately behind polystyrene. The evolution of hydrogen from the polyethylene results not only in the cross-linked structure with improved properties, but also in double bonds, unreacted free radicals, and, for the material irradiated in air, oxygenated structures. Thus, a number of reactions may occur in the postirradiation period. As the packaging material must retain its desirable properties over extended periods of time, it is possible that storage could result in an altered product.

A ranking of the plastics films studied should be constructed, therefore, based not only on the total quantities of products, but also on the nature of the products, and their interaction with the food systems. The subjects of toxicity and off-odors or taste were beyond the scope of this investigation.

Based on a paper presented at the 15th Annual Technical Conference of the Society of Plastics Engineers, Inc., 65 Prospect St., Stamford, Conn.

▼ ▼ ▼

Creep Rupture Tests

By E. A. Davis

Mechanics Dept.
Westinghouse Research Lab.
Pittsburgh, Pa.

Creep rupture tests on tubular specimens of type 316 stainless steel were run at 1200 F and at pressures up to 24,000 psi. The specimens were tested under pure internal pressure and equal biaxial tensions. The results of these tests correlate favorably with those of uniaxial tension tests if a comparison is made on the basis of effective stress and effective strain rate.

Based on paper presented at the Metals Engineering Conference of The American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

Fundamental Studies of Ultrasonic Welding

By R. E. Monroe
N. E. Weare
J. N. Antonevich

Battelle Memorial Institute
Columbus, Ohio

An understanding of the fundamental factor involved is important in the use of any welding process. Studies related to ultrasonic welding were made to determine the mechanism of bonding, the effects of welding variables, and the effects of material factors. After preliminary tests indicated the importance of heat generated at the weld interface, apparently from a simple friction reaction, a simplified welding system was used for further studies of the mechanism of bonding. Sphere-plate welds involving a single interface which allowed precise measurement of phenomena occurring during welding were made in this system.

Much of the data obtained thus far have indicated that bonding is due to the formation of a thin molten film in the interface. However, since no definite proof of this mechanism has been obtained, there remains the possibility of solid state bonding. A study of literature regarding friction has aided in the derivation of some equations which may be helpful in mathematically expressing the important factors involved in ultrasonic welding conditions. These equations show the relation between the physical and mechanical properties of metals, ultrasonic welding conditions and the temperatures required to produce welds. Additional work is needed to integrate the continuing changes in properties and contact area that occur during welding into these equations.

Studies were made to determine the effects of welding conditions on the properties of ultrasonic welds. Aluminum (1100) was used in most of these studies. Dominate materials factors prevent extending the results of these studies to cover all metals. The strength of aluminum ultrasonic welds increases in a nearly linear manner with increased tip displacement. Strength rises rapidly with increases in welding time to a maximum value in the first few seconds and then remains constant. Increased clamping pressure increases weld strength linearly to a maximum value at which strength then levels off or becomes less at higher clamping pressures. No differences in weld properties were noted for aluminum welds made with three or six-inch radius weld tips with either rough or smooth tip surfaces. Improvements in breaking loads were made by using a three-inch instead of a 5/16-inch tip for welding stainless steel to titanium. The effects of weld tip or anvil material were not studied extensively; however, it was shown that stronger welds, and higher interfacial temperatures were obtained if the weld tip and anvil material had a low thermal conductivity.

The strength of welds in aluminum was not affected by removing the oxide film before welding. Welds made in gold indicated that bonds were readily made in soft metals possessing no surface oxide. As the thickness of material or degree of prior cold work increased, higher energy inputs were required to obtain ultrasonic welds.

Based on a paper presented at AWS 40th Annual Meeting and AIEE Electric Welding Conference of the American Welding Society, 33 W. 39th St., New York 18, N. Y.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

Machine Tool Obsolescence

By Leo A. Hoegh

Director
Office of Civil and Defense Mobilization
Washington, D. C.

I know there is a long way to go to achieve sufficient modernization of the entire metalworking industry. In 1945, 38 percent of our machine tools were at least ten years old. In 1949, the percentage had climbed to 43 percent. In 1953, 56 percent were in this category, and 60 percent in 1958. More machine tools are overage now than at any time since the 1930's. These facts are not confined to a few industries, in a few areas —the condition is distributed throughout all of metalworking.

We have started the attack on this problem. The last Congress enacted a "small business" accelerated depreciation provision, allowing a 20 percent write off of the value of new or used depreciable property in the first year, up to $20,000 of acquisition in any one year. Aid giving tax provisions were employed on a large scale in 1940 and again in 1950 to help induce the development of defense production facilities with a minimum of delay.

Based on a talk presented at the Machine Tool Distributors Association, 1900 Arch St., Philadelphia 3, Pa.

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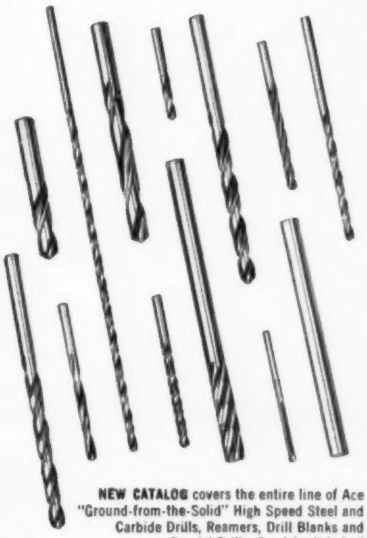

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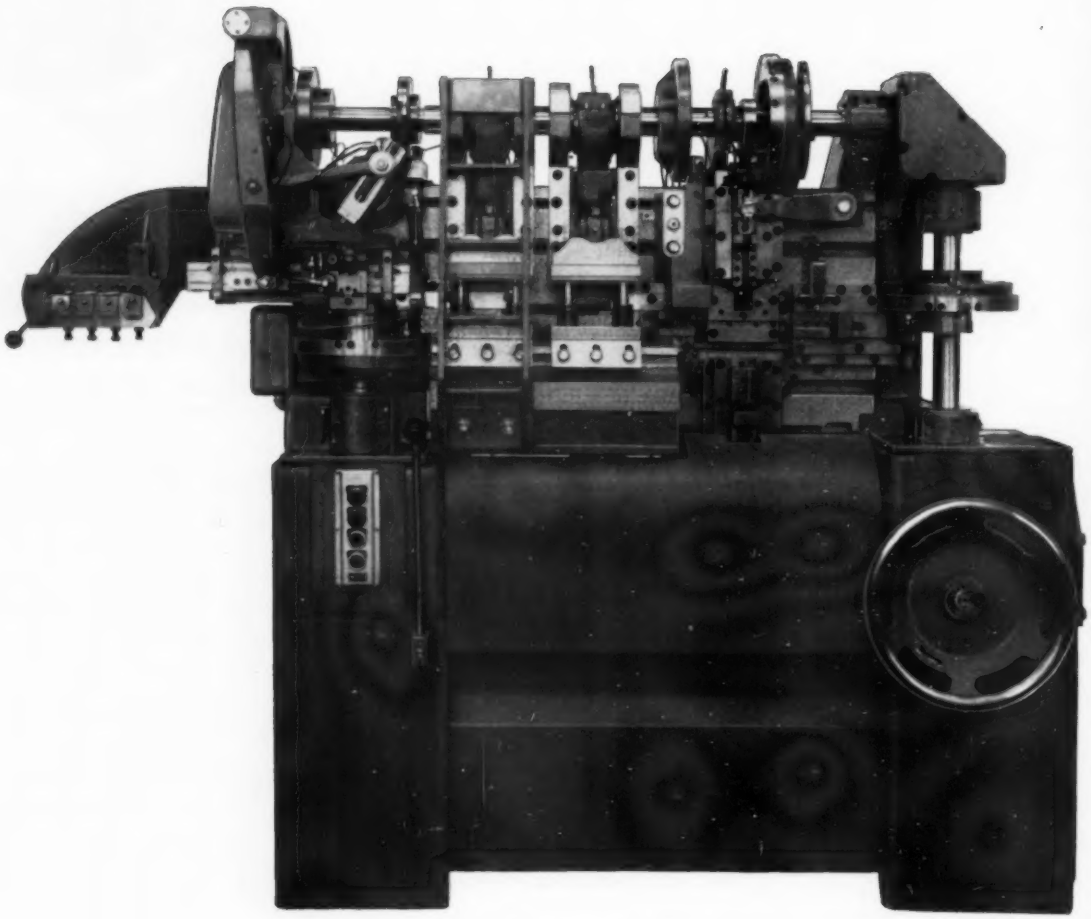

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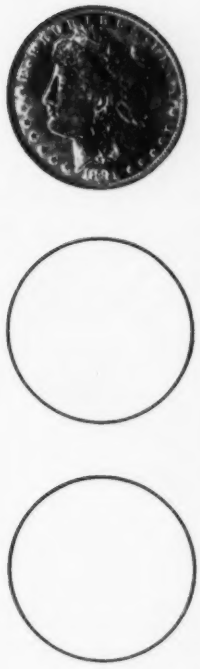

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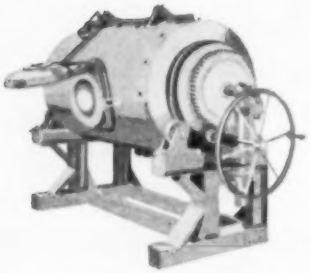
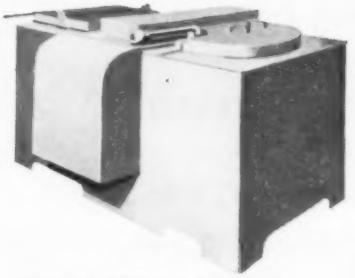
Wherever industry needs heat ... There's LINDBERG equipment just right for the specific job

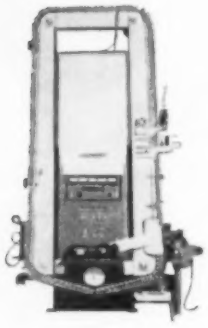


Rotary Open-Flame Smelting Furnaces: Lindberg-Fisher Simplex (shown) either oil or gas fired with capacities to 30,000 lbs. brass, 2,400 lbs. aluminum.

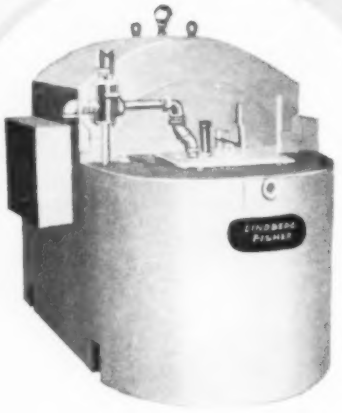
Automatic Ladling Units: The Autoladle "Little Joe". The first practical automatic aluminum ladling unit yet devised.



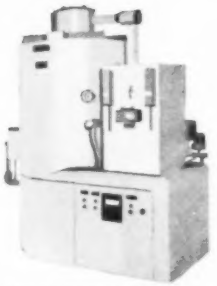
Induction Melting and Holding Furnaces: Lindberg-Fisher two-chamber furnace (shown) melts in one chamber, holds at correct temperature in other.



High Frequency Units: Vertically designed, completely automatic "HF" unit (Shown) for aluminizing automotive valves.

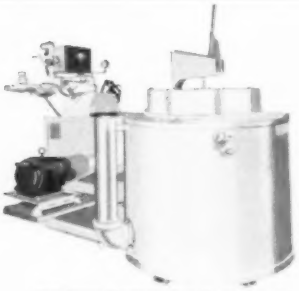


Melting and Holding Furnaces: Electric resistance furnace (shown) with capacities of 750 lbs. to 1500 lbs.

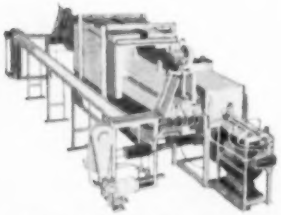


Atmosphere Generators: Hyen generator (shown) for endothermic atmospheres. Generators for all required atmospheres.

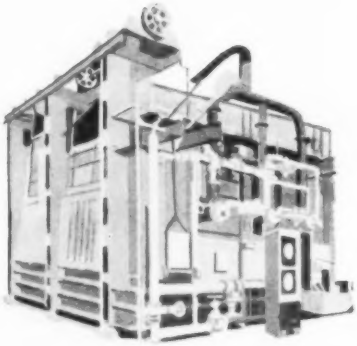
Pilot Plant Equipment: Atmosphere tube unit (shown) for ceramic research and development at temperatures up to 2750° F.



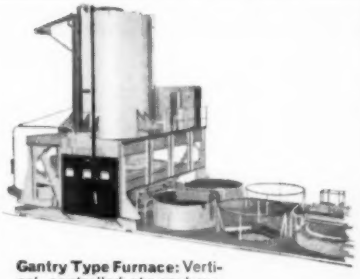
Cyclone Tempering Furnaces: Batch type fuel-fired tempering furnace (shown). Famous in metal treating industry for years.



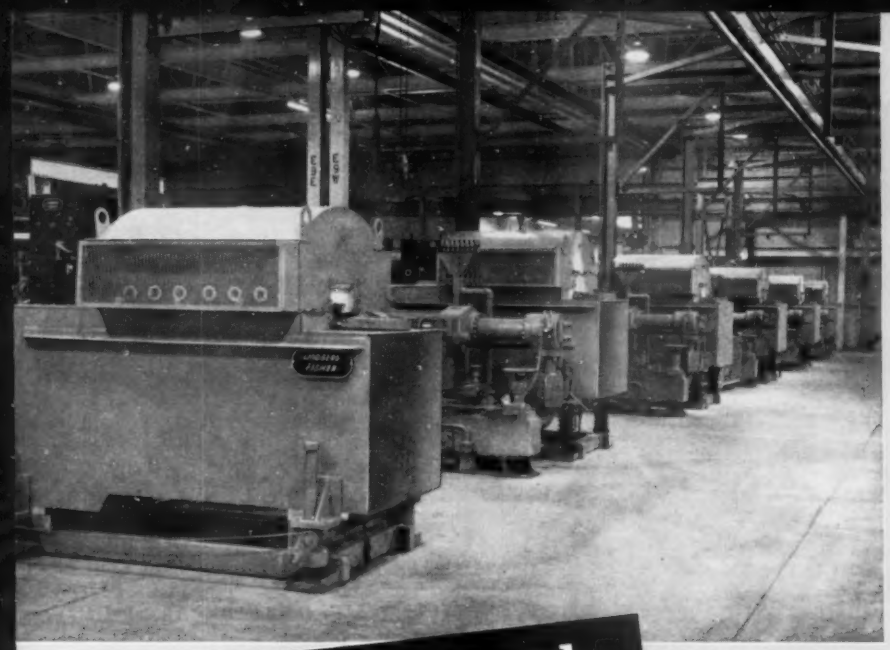
Ceramic Kilns: Fully automatic, atmosphere controlled kiln (shown) has 5 control zones for flexibility. Maximum temperature, 2700° F.



Aluminum Reverberatory Furnaces: Twin-chamber melting and holding furnace (shown) with 45,000 lbs. capacity.



Gantry Type Furnace: Vertical, controlled-atmosphere, drop bottom, hardening furnace. Complete installation field-installed by Lindberg.



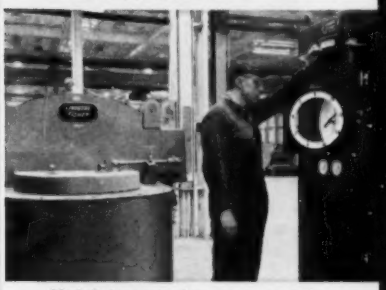
Lindberg-Designed

furnaces, more than 75 of them, help Ford Motor Company maintain casting production and quality standards

The new Aluminum Castings Plant of Ford Motor Company, Engine and Foundry Division, at Sheffield, Alabama, is a model of modern production efficiency. Contributing to its effective operation is a huge battery of Lindberg-Fisher aluminum holding furnaces, more than 75 of them. Eight large 65,000 lb. capacity reverberatory holding furnaces receive molten aluminum delivered from an adjacent Reynolds Metals plant and hold it at the desired temperature. Six other reverberatory furnaces, each with 20,000 lb. capacity, are used for remelting scrap aluminum from trimmed parts and holding metal at its usable temperatures. Molten metal is then delivered to more than 60 electric resistance holding furnaces in the casting area as needed. This unique installation, developed by Ford engineers in conjunction with Lindberg, is a major factor in maintaining the high quality product and production standards required by Ford.

Lindberg equipment and Lindberg planning can help you find the most effective answer to any problem of applying heat to industry. We cover the field, melting and holding, heat treating, tempering, brazing, enameling furnaces, ceramic kilns, high frequency units, and are in the ideal position to recommend just the type of equipment most suitable for your needs. This can be factory built or field-installed in your own plant, fuel-fired or electric. Consult your local Lindberg Field Representative (see the classified phone book) or get in touch with us direct. Lindberg-Fisher Division, Lindberg Engineering Company, 2447 West Hubbard Street, Chicago 12, Illinois. Los Angeles Plant: 11937 South Regentview Avenue, at Downey, California.

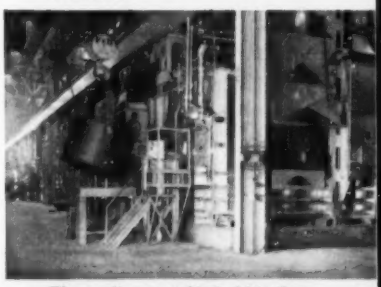
Handsome entrance to new plant of Ford Motor Company, Sheffield, Alabama.



Metal temperatures are positively controlled through Lindberg Control Panel.

Some furnaces are arranged for hand ladling and others are equipped with Lindberg Autoladle.

Molten aluminum is delivered direct to reverberatory holding furnaces.



The molten metal is held in these 14 huge furnaces for distribution to the casting areas.

LINDBERG heat for industry

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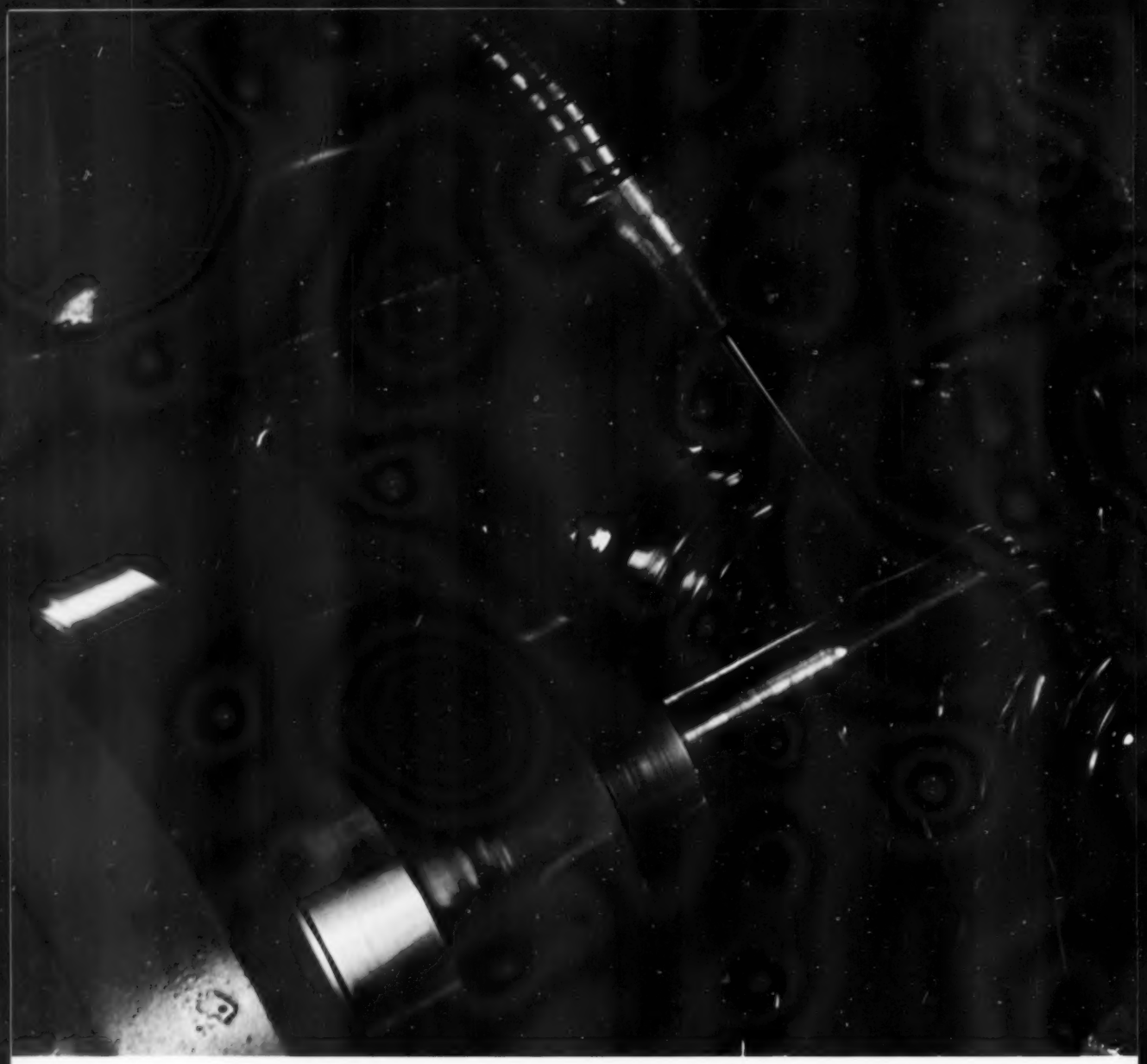

Doubles production of splined shafts per hob shift with

GULF MAKES THINGS

"Until recently, we were using a soluble oil in the hobbing of flutes on the rifle bars for our Cleveland Le Roi drills. Then, when we installed a new gear hobber, we switched to Gulfcut 21C, a sulfurized mineral cutting oil. Since then, using the same type of hob as before, we have doubled hob life on this job and now machine twice as many rifle bars between grinds."

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"With the previous cutting oil," reports Mr. Moffat, "we were getting only 7 finished spline shafts from each hob shift, between grinds. Feed and speed were .0135 ipr and 154 rpm respectively. With Gulfcut 21C, our feed is now .018 ipr with a speed of 200 rpm. We now turn out 12-14 pieces between grinds, double our previous production. With hobs at $100 each, this amounts to quite a saving in tool costs.

"We're also getting better finishes with the help of Gulfcut 21C, and we find it much easier to stay within our specified tolerances."

Why does Cleveland Rock Drill get such good results with Gulfcut 21C? Because it provides greater sulfur activity over a wide range of machining operations.

The "rock room" where Cleveland Le Roi drills are given rugged tests before shipment. At left, Gordon Moffat, Factory Superintendent at Cleveland Rock Drill Plant. Right, T. F. Irving, Gulf Sales Representative.

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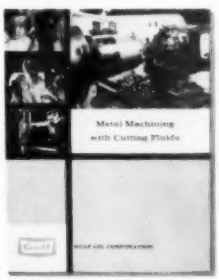
Gulfcut 21C is one of the high performance cutting oils in the Gulfcut line. See how Gulfcut can help improve your machining practices. Call your Gulf office, or use coupon for more information.



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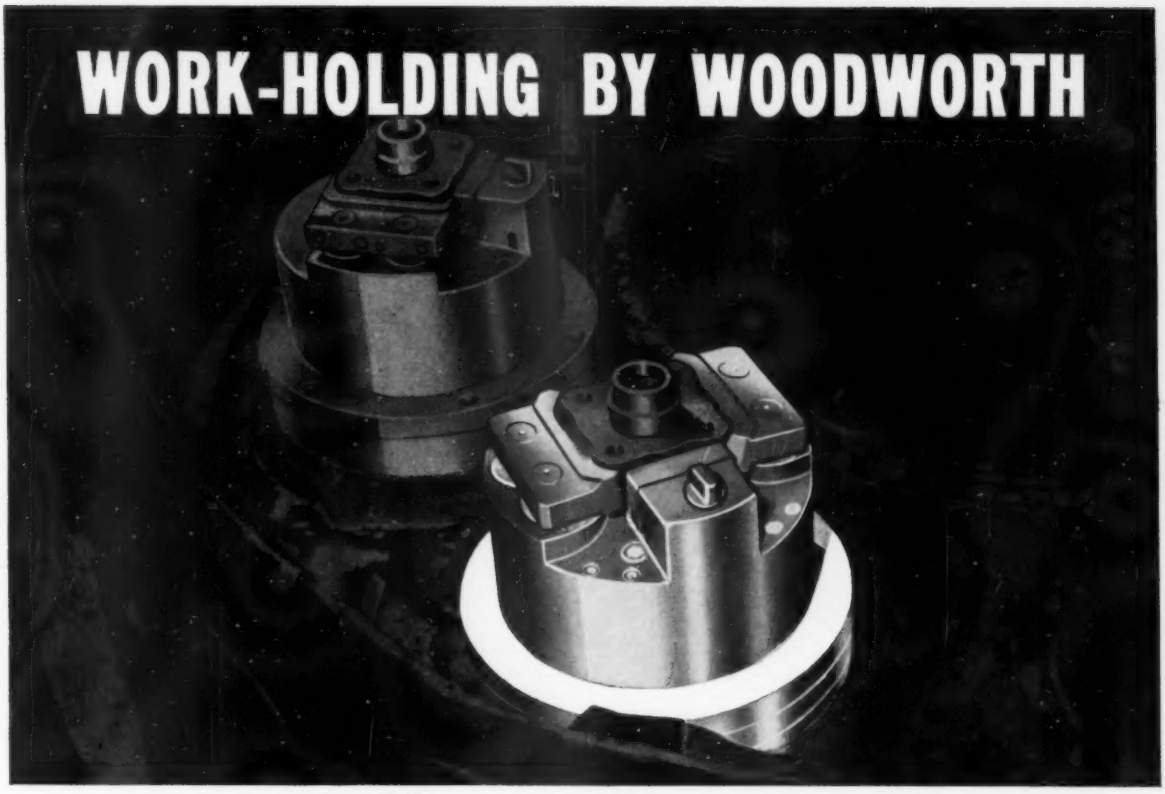

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for fast, free-cutting...high production...long wheel life

SIMONDS WHEELS FOR CENTERLESS GRINDING

"Ground 70,000 pieces compared to 45,000." "Held corners and shape better than wheels previously used." "Entirely satisfactory. Gave excellent finish." These comments from users* are some reasons why Simonds Centerless Wheels are rated superior for job-to-job dependability . . . and good reasons why *your* way to accurate, lower cost centerless grinding may lie in switching to Simonds Wheels. Write for bulletin ESA 55.

*Names on request.

CALL YOUR SIMONDS DISTRIBUTOR

Proven products
Dependable know-how
Quick supply

SIMONDS ABRASIVE COMPANY

Tacony & Fraley Sts. • Philadelphia 37, Pa.

Division of Simonds Saw and Steel Co.

REGULATING WHEEL

Rubber bonded feed wheels exceptionally long wearing and have good traction . . . perfect mate for the Simonds Grinding Wheel.

GRINDING WHEEL

Job-proved Grain and Grade Specifications for all materials. Karvit bushed non-metallic center hole for better mounting and balance.

BRANCHES: CHICAGO • DETROIT • LOS ANGELES • PHILADELPHIA • PORTLAND, ORE. • SAN FRANCISCO • SHREVEPORT
IN CANADA: SIMONDS CANADA SAW CO., LTD., GRINDING WHEELS DIVISION, BROCKVILLE, ONTARIO

BRISTOL

socket cap screws meet newly established industry standards

Have higher strength, greater holding power than ever

Bristol socket cap screws are now available to meet all the recommendations of the Socket Screw Manufacturers' Committee standards.

These new standards—plus Bristol's stringently applied quality-control—are setting a new high for performance. Check these advantages:

- Great bearing surface under the head because of increased head diameter (1½ times body diameter).
- Less need for washers, less indenting of metal.
- Greater holding power under shock and vibration.
- Larger socket—you can wrench-up screw tighter.
- Greater engagement of head, greater clamping power.

These new Bristol socket screws are just one important example of the way Bristol develops new products to meet the needs of modern manufacturing.

You'll find precision Bristol socket screws—both hex and Bristol Multiple-Spline—in a wide variety of equipment today. They're used by the millions in machinery, machine tools, appliances, instruments, computers, aircraft and missiles (including count-down, tracking, and ground-support equipment), and wherever highest standards of quality and reliability are imposed. A.9.1

Old dimensional standards will continue to be available.

Precision socket screw manufacturers since 1913

*Made in sizes as small as No. 0 in Alloy Steel and Stainless Steel. Cap screws up to 1½" diam.

THE BRISTOL COMPANY Socket Screw Division Waterbury 20, Conn.

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DYKEM
STEEL BLUE
Stops Losses
making Dies and Templates
DYKEM STEEL BLUE
SPECIMEN
With DYKEM Steel Blue
Without DYKEM Steel Blue
Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.
Write for sample on company letterhead
THE DYKEM COMPANY
2303D North 11th St. • St. Louis 6, Mo.

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MARVECO LIVE CENTERS
Guaranteed to outperform and outlast any other LIVE CENTER.
The WHOLE HEAD turns on Double Row Ball Bearings for Radial Load and Tapered Roller Bearings for Thrust Load.
MARVEL TOOL & MACHINE CO.
1086 North River Road • St. Clair, Michigan

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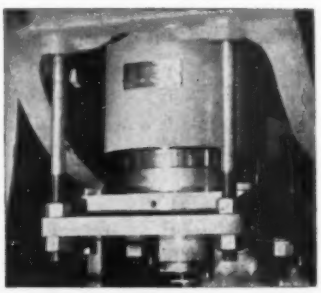
DIE CUSHIONS

by Dayton Rogers

FOR ALL PUNCH PRESSES

to assure accurate working pressure on all dies

- Single installations from 1 ton to multiple installations of unlimited capacity, standard or designed on the job.
- Best possible delivery.
- Quotations on request.



11 Ton Full Universal Pneumatic Die Cushion Installed on Inclinable Press

WRITE FOR CATALOG F-44-A

DAYTON ROGERS *Manufacturing Company*

MINNEAPOLIS 7K, MINNESOTA

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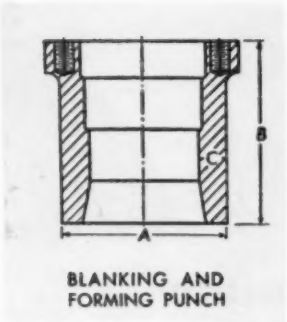
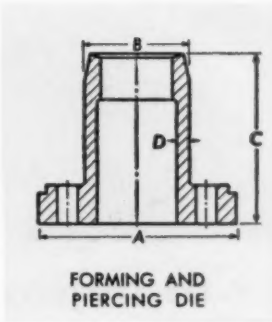
THIS HOLE IN GRAPH-MO HOLLOW-BAR®

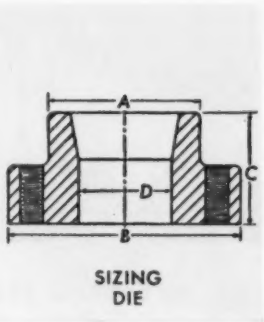
lets you make ring-shaped tool steel parts faster, at less cost



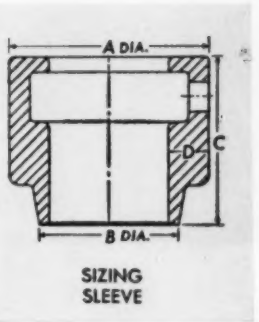
BLANKING AND FORMING PUNCH



FORMING AND PIERCING DIE



SIZING DIE



SIZING SLEEVE

START making your ring-shaped tool steel parts with Graph-Mo Hollow-Bar® and you save one operation immediately. You eliminate drilling because the hole is already there. Your first step is finish boring.

That's just the start of your savings. You can make parts faster because Graph-Mo machines 30% faster than ordinary tool steels. The free graphite in its structure is the reason.

Graph-Mo wears longer because of the diamond-hard carbides in its structure. Users report Graph-Mo outwears conventional tool steels by 3 to 1. And there's far less tendency to pick up, scuff and gall.

And for stability, you can't beat Graph-Mo anywhere. A master plug gage machined from Graph-Mo showed less than 10 millionths of an inch dimensional change *after 12 years of use.*

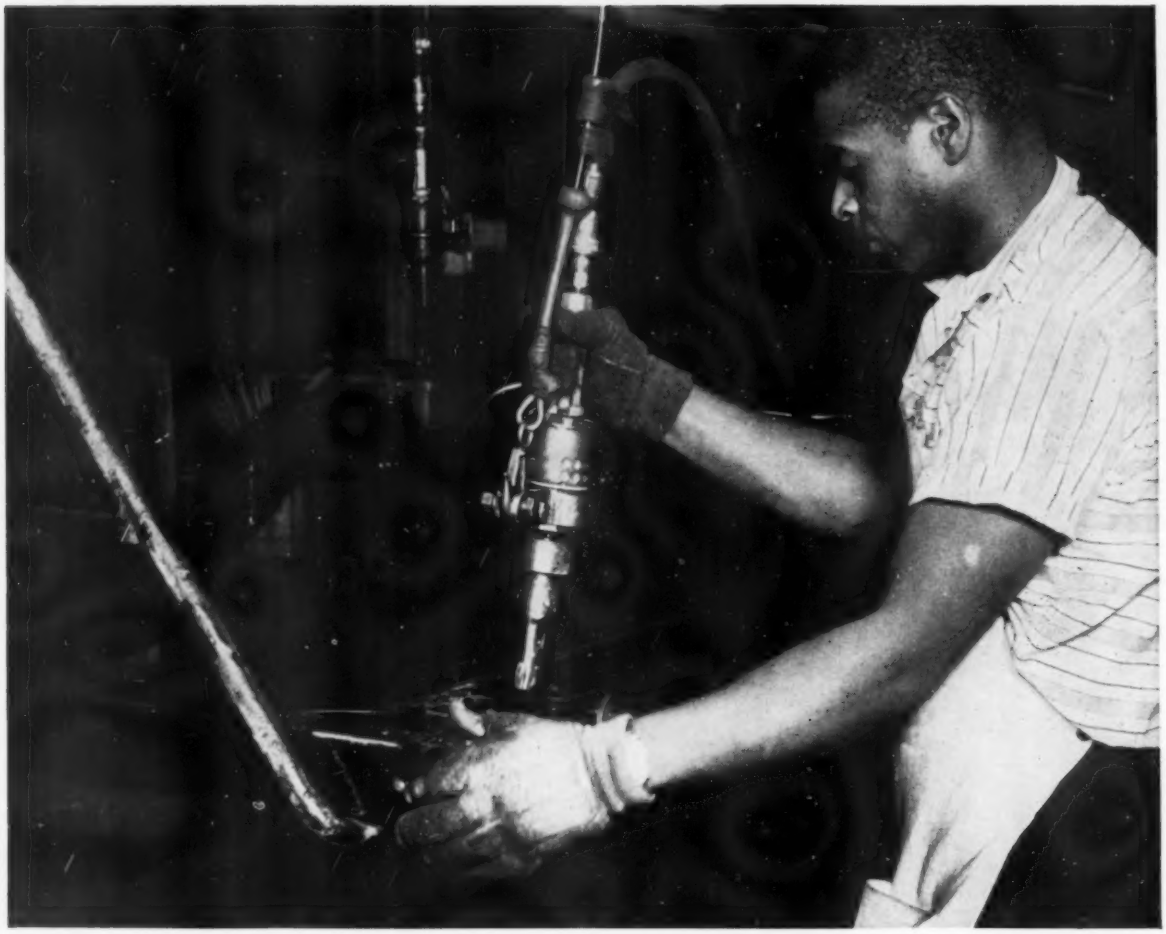
For your ring-shaped parts, save as other tool makers do. Specify Graph-Mo Hollow-Bar. It will save you time and money, give you better finished products. Sizes range from 2 to 16-inch O.D. Many wall thicknesses. Write The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.*

WHEN YOU BUY TIMKEN STEEL YOU GET . . .

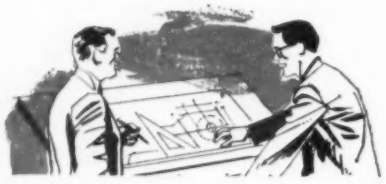
1. Quality that's uniform from heat to heat, bar to bar, order to order
2. Service from the experts in specialty steel
3. Over 40 years experience in solving tough steel problems

TIMKEN® *Fine Alloy* STEEL

"TIMKEN GRAPHITIC STEELS ARE CARRIED IN STOCK BY 9 DISTRIBUTORS WITH 42 WAREHOUSES IN 31 CITIES IN THE UNITED STATES AND CANADA"



How to solve next-to-impossible nut running jobs . . . fast



IN INDUSTRY—SPEEDING THE PACE,

the Gardner-Denver specialist is an integral part of the team. He works side by side with engineers and designers, helping to solve their problems, for at Gardner-Denver there's no substitute for men—our 100-year philosophy of growth.

Close-quarter or odd-angle nut running problems? Solve these and other tough ones quickly and easily with a Gardner-Denver ratchet wrench. Typical example is above assembly of rear spring shackle nut on auto frame.

Flat driving-end of the wrench fits into spaces too small for other power tools—places usually inaccessible to anything but hand and open-end ratchets.

This wrench is available with a variety of attachments for a wide range of job applications: extra thin, extended, angular, open-end, and many socket styles. Either tighten or remove nuts by simply turning the tool over.

Gardner-Denver ratchet wrenches are available in five motor sizes to provide wide ranges of speeds and torques. Write for Bulletin 17.

GARDNER-DENVER Since 1859

100 1959 YEARS

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

What do you want in an inclinable?

AIR FRICTION CLUTCH? MECHANICAL CLUTCH?
FLYWHEEL OR GEARED PRESS?
SINGLE OR DOUBLE CRANK? AUTOMATIC FEEDS?
10 TON...200 TON?

Don't settle for "second-best" when the best may cost you less! Chances are whatever your needs in an inclinable, it's a Bliss standard—simply because Bliss makes more types and sizes of inclinable presses than any other builder. In fact, someone else's "special" may be a Bliss standard. Check it out for yourself before you buy—write for our most recent inclinable catalogs and data sheets. You'll see that size for size, no matter what you want in an inclinable, you get more press from Bliss . . . large crankpins, long strokes, greater openings, bigger beds and many other extra values. A press that's backed by a century of press engineering . . . by competent counsel . . . by a **dependable** parts and service program. In short, you'd be wise to check Bliss—**first!**

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Bliss is more than a name...
it's a guarantee!

PRESSES • ROLLING MILLS • ROLLS
DIE SETS • CAN MACHINERY • CONTRACT MANUFACTURING

USE READER SERVICE CARD, CIRCLE 128

***Experience**—the added alloy in **Allegheny Ludlum** tool steels*

Careful addition of sulfur to melt guarantees typical sulfide distribution, as shown in photomicrograph of longitudinal specimen of EZ MACHINING tool steel.

Sulfur addition to melt held to narrow range in Allegheny Ludlum's EZ MACHINING GRADES

Uniform, finely-distributed sulfides mean uniform machining, uniform high finish, uniform long tool life order after order

Adding sulfur, actually an impurity, to a tool steel melt to make it free-machining must be done with care and precision. That's why Allegheny Ludlum maintains an extremely close average range in adding sulfur to its EZ MACHINING grades. But mere range, however narrow, is not enough. A-L has developed special techniques in adding sulfur and nucleating agents to produce the uniform, finely-distributed sulfides that characterize good free-machining tool steels.

A-L's extra care means you can standardize your machining operations from piece to piece and order to order. This reproducibility is reflected in uniform *machining;* uniform *high finish;* uniform *long tool life.*

For example, in the production of hobs these machining properties in Allegheny Ludlum's EZ MACHINING steels minimize the costly "backing off" operation for back clearance of multiple teeth, eliminating complicated extra heat treatment. Lower residual stresses are set up, because the steel has a lower resistance to the cutting action. Naturally, hobbing is only one of the situations where these free-machining characteristics can benefit you.

Allegheny Ludlum stocks a complete line of tool steel sizes and grades. Call your nearest A-L representative; you'll get quick service and counsel on such problems as heat treating, machining, grade selection, etc. Or write for A-L's publication list which gives full data on the more than 125 technical publications offered. They'll make your job easier.

ALLEGHENY LUDLUM STEEL CORPORATION, Oliver Building, Pittsburgh 22, Pa. Address Dept. TE-22

WSW 7299

ALLEGHENY LUDLUM

Tool Steel warehouse stocks throughout the country ..Check the yellow pages

every grade of tool steel ... every help in using it

For complete chain drives ¼" to 2" pitch . . .

BOSTON Gear SPROCKETS and CHAIN

FROM STOCK . . . at Factory Prices

Catalog No. 57 lists

ANY TYPE OR SIZE YOU NEED

.81" to 50.94" P.D. SPROCKETS, iron and steel, for single ROLLER CHAIN

1.92" to 26.74" P.D. SPROCKETS, iron and steel, for double ROLLER CHAIN

¼" to 2½" P. ROLLER CHAIN single, double, and triple strand

DOUBLE PITCH ROLLER CHAIN
1", 1¼", 1½" P. Drive Series
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1.94" to 12.74" P.D. SPROCKETS, iron and steel, for BLOCK CHAIN
⅛" to ½" w. BLOCK CHAIN

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Save machining time

SHOLD-A-GRIP interchangeable tapered SPROCKETS and BUSHINGS
2.09" to 23.88" P.D. SPROCKETS adaptable with tapered BUSHINGS to shaft sizes ½" to 3" by 16ths

BORED-TO-SIZE ready-to-install SPROCKET PINIONS
Complete with keyway and setscrew. ⅜" through 1" P., in 86 pinion sizes, with 360 stock bores

Order from your local Distributor. You save time and expense — you get BOSTON Gear top-rated quality and lasting economy. Be cost-wise — standardize. Boston Gear Works, 83 Hayward St., Quincy 71, Mass.

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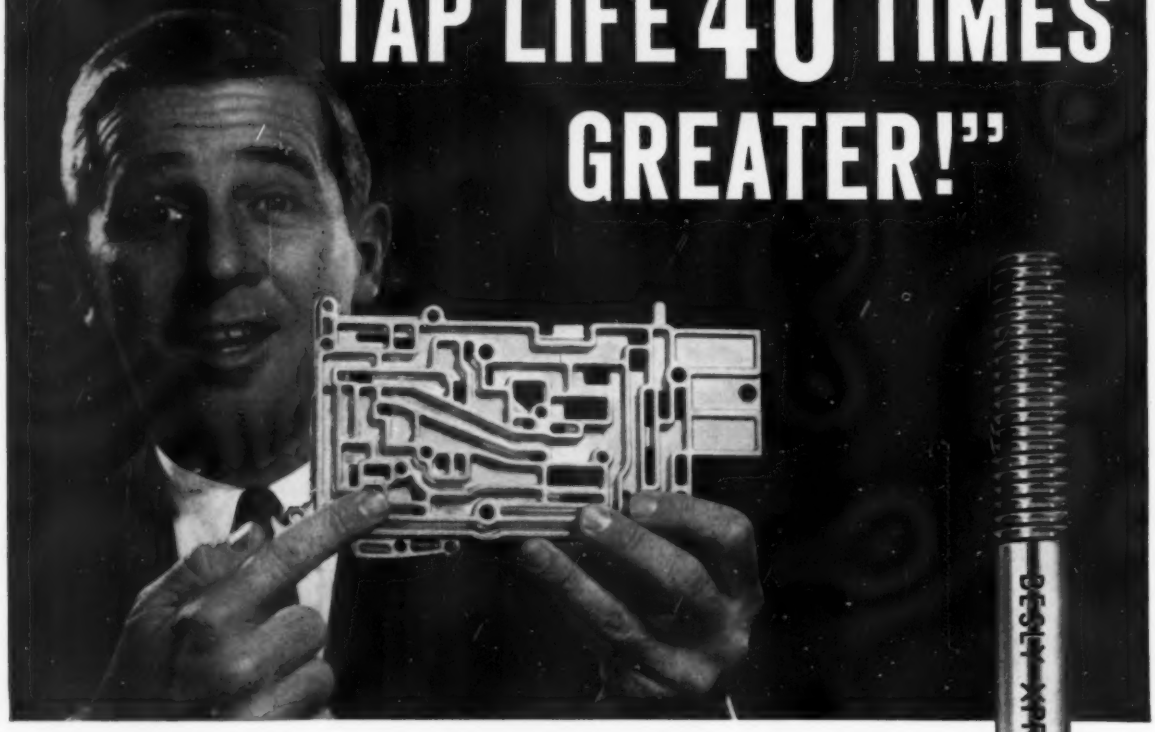
9496 "OFF-THE-SHELF" TRANSMISSION PRODUCTS **FROM STOCK** — AT FACTORY PRICES — ASK FOR CATALOG
Stock Gears • Sprockets and Chain • Speed Reducers • Bearings • Pillow Blocks • Couplings

"TAP LIFE 40 TIMES GREATER!"

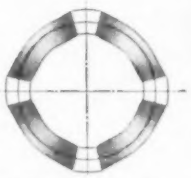


BESLY X-PRESS® TAPS—based on a new cold-forming principle—help boost production and cut downtime. A leading automotive transmission builder used to make this aluminum die cast transmission channel plate at an average rate of 1,000 to 1,500 holes per tap. Eleven 10-24 through holes had to be tapped in each plate. Production was low due to excessive tool breakage and downtime.

When the transmission builder changed to Besly 10-24 B-4 X-Press Taps, they averaged 59,450 holes per tap. Tool life increased 40 to 1. Production went up. Tap breakage, tool costs, and downtime descended sharply.

UNIQUE CAM-RELIEF DESIGN with taper point enables X-Press Taps to excel conventional cutting taps for faster production and longer life. Chips eliminated because the X-Press Tap cold-forms internal threads without cutting. Breakage is less. More pieces are tapped per hour.

Besly X-Press Taps are ideal for either blind or through holes and are recommended for copper, brass, zinc, leaded steels, aluminum, lead, die castings, and other ductile metals.



Cross-section showing unique cam-relief design

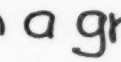
Call your Besly distributor or write us today for new booklet containing complete data.

BESLY®

BESLY-WELLES CORPORATION

118 Dearborn Ave., South Beloit, Illinois

Grinders and Abrasives • Taps • X-Press Taps® • Drills • Reamers • End Mills • Tool Bits • Gages • Carbide Tipped Tools, Blanks, Lapped Toss-away Inserts and Holders

If it rolls on an axle or turns in a bearing or rides on a shaft
if it slides in a groove  or moves
on a pivot if it bores or
cuts or transmits pressure
one of Sinclair's 500
specialized lubricants is
designed to make it work better.
For answers to your lubrication
problems, write today to

SINCLAIR REFINING COMPANY

Technical Service Division
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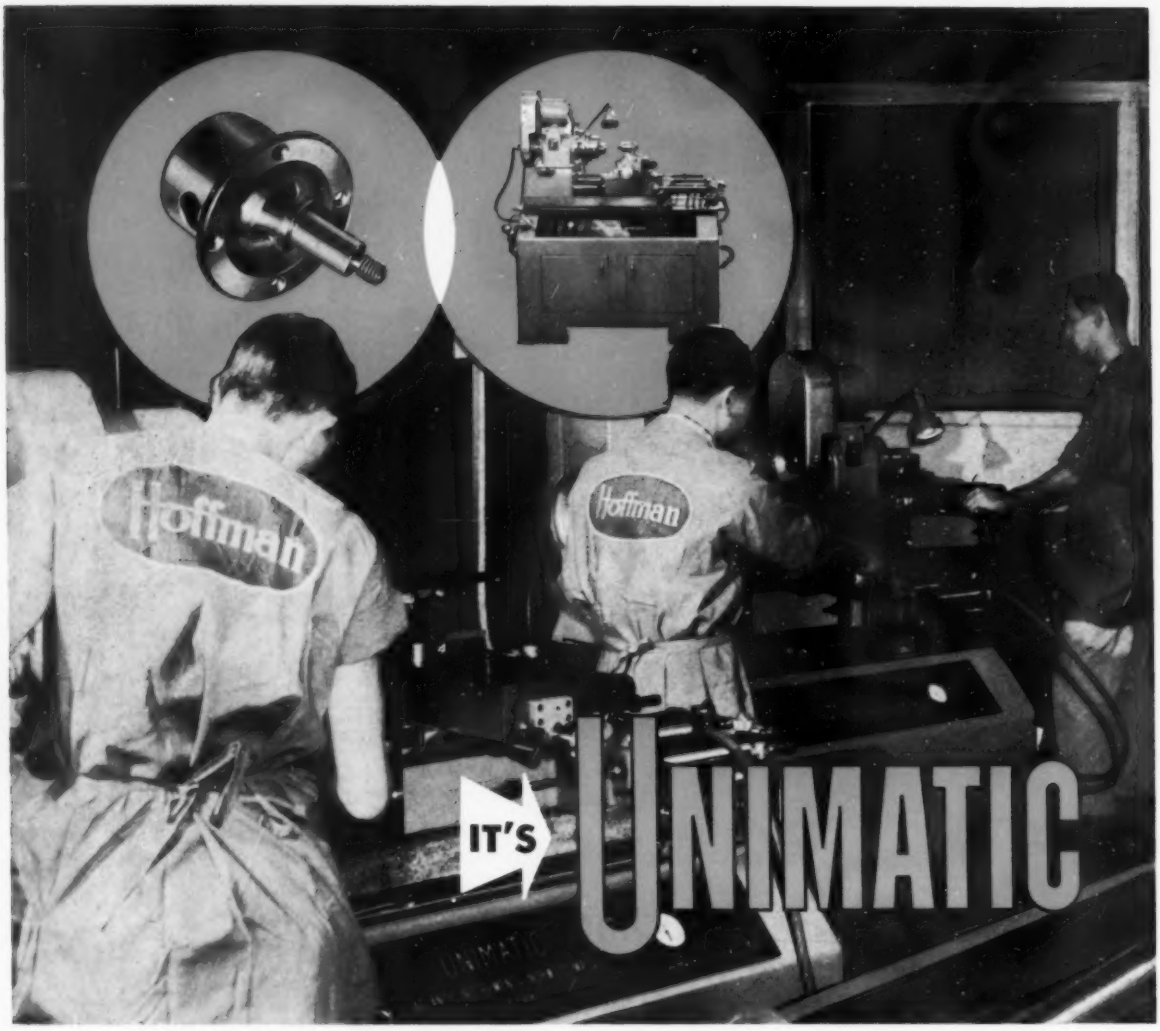
Sinclair



...*precision* for HOFFMAN ELECTRONICS

Where accuracy is the prime concern, the UNIMATIC rates high. The Electro-Mechanical Department of Hoffman Electronics, Inc., with stiff tolerances, combines the required accuracy and high production with their battery of five UNIMATICS purchased over a period of years.

The work example shown, of 303 Stainless Steel, is air chucked with a minimum of pressure to prevent distortion. A fine finish is obtained by turning the "part" at 770 RPM with a .003" feed using a standard carbide tool.

The part is faced, bored and turned. The first bore of .281" is held to .0005"; the second bore of .3125" to .0001"; the third of .346" to .0005"

A special chuck provides for turning at working feed, skipping intervening space at fast traverse followed by working feed again.

The UNIMATIC is guaranteed to produce repetitively to .0002" tolerance *but will actually do better!* We have actual applications where tolerances of .00005" are maintained!

RUSSELL, HOLBROOK & HENDERSON, INC.

292 Madison Avenue, New York 17, N. Y.

BRUNSON OPTICAL TOOLING

Slashes Inspection Time UP TO 50%

IN VITAL MISSILE WORK FOR REYNOLDS METALS COMPANY

The close tolerance of ballistic shells demand great accuracy of measurement—a laborious, time-taking job with conventional equipment. Progressive Reynolds Metals Company, performing vital missile work has solved this problem with Brunson optical tooling equipment and the unique tooling dock shown above.

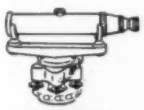
The tooling dock is a permanently located measuring device which completely surrounds the section being checked. Measurements are achieved by Brunson optical transits squares moving along calibrated rails parallel to fixed line of sights.

By means of this Brunson optical tooling set-up, Reynolds Metals is able to read dimensions to .001" accuracy, has slashed inspection time from 35 man-hours to 16 man-hours for certain missile sections.

Brunson optical tooling offers you the most efficient, convenient, and economical method yet developed to obtain the accuracy required for most of today's manufacturing operations —alignment of wheels, rolls and axles; resetting large workpieces; construction of jigs and mock-ups; and for all types of precision measurement. Outstanding in Brunson's advanced line of equipment is the exclusive self-proving optical transit square.

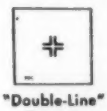
Look to Bruning for the *Complete* Line of Optical Tooling Equipment

Optical Transit Squares, Jig Transits



Alignment Telescopes

Horizontal and Vertical Tooling Bars



"Double-Line" Targets

This comprehensive 20-page booklet covers Brunson optical tooling—principles, applications, and equipment. It's a gold mine of information you would find difficult to obtain elsewhere. Yours free!

BRUNING **BRUNSON**

Charles Bruning Company, Inc., Dept. 10-PP
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Please send me my free copy of the Bruning optical tooling booklet.

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Company_____

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City_____ County_____ State_____

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HIGH FREQUENCY INDUCTION HEATING UNITS

BRAZING · BOMBARDING · SOLDERING · MELTING · HARDENING · ANNEALING

The Lepel line of induction heating equipment represents the most advanced thought in the field of electronics as well as the most practical and efficient source of heat yet developed for numerous industrial applications.

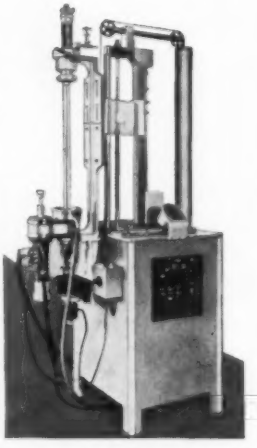
If you are interested in induction heating you are invited to send samples of the work with specifications. Our engineers will process and return the completed job with full data and recommendations without any cost or obligations.

FLOATING ZONE FIXTURE FOR METAL REFINING AND CRYSTAL GROWING

A new floating zone fixture for the production of ultra-high purity metals and semi-conductor materials. Purification or crystal growing is achieved by traversing a narrow molten zone along the length of the process bar while it is being supported vertically in vacuum or inert gas. Designed primarily for production purposes, Model HCP also provides great flexibility for laboratory studies.

Features

- A smooth, positive mechanical drive system with continuously variable up, down and rotational speeds, all independently controlled.
- An arrangement to rapidly center the process bar within a straight walled quartz tube supported between gas-tight, water-cooled end plates. Placement of the quartz tube is rather simple and adapters can be used to accomodate larger diameter tubes for larger process bars.
- Continuous water cooling for the outside of the quartz tube during operation.
- Assembly and dis-assemby of this system including removal of the completed process bar is simple and rapid.



Model HCP

Electronic Tube Generators from 1 kw to 100 kw.
Spark Gap Converters from 2 kw to 30 kw.

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All Lepel equipment is certified to comply with the requirements of the Federal Communications Commission.

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JEMCO MACHINE TOOLS

PUNCH SHAPER—SAVE FROM 50% to 80% MACHINING TIME. Machines contour surfaces, metal stamping punches with curved necks, brass electrods, etc. Complete in one set-up to within a guaranteed accuracy of ±.00025".
Let us quote on your special punch requirements.

10 SPEED TURRET DRILL HEAD—SAVE FROM 40% to 60% MACHINING TIME. Fits any single spindle vertical drill press or miller. Drills 2 to 7 holes . . . taps 2 to 7 sizes in one set-up.

QUICK SET UP TOOL ROOM SHAPER—completely equipped—all set-ups take less than 5 minutes.

DISC FILER—Eliminates hand filing—for all metals, wood & plastic.

DRILL GRINDERS — Range .012" to 3".

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FROM THIS
Cylinder before expanding, 15" dia., 16" long. Mtl., mild steel, .050" thick. After expanding, dia. at flanges, 19", lgth., 12".
TO THIS

Grotnes Expanders, with low cost tooling, close tolerances, high production rates, cold form parts ranging from 4" to 100" in diameter, 1 inch to 15 feet in height. Write for details.

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MACHINE WORKS
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TAPER LENGTH REGULAR MILLING
TAPER LENGTH HEAVY DUTY HY-SPIRAL
HEAVY DUTY OR COTTER PIN DRILLS
LOW HELIX OR DRILLS FOR BRASS
HY-SPIRAL OR HIGH HELIX DRILLS
JOBBERS LENGTH COBALT DRILLS
DRILLS FOR PLASTICS
TEST RECORD

TEST after TEST

proves the economy of using CLE-FORGE SPECIAL PURPOSE DRILLS

Time after time CLE-FORGE Special Purpose Drills have clearly demonstrated their ability to produce *more holes* at *lower cost,* as proved by hundreds of actual tests in customers' plants. Typical records show that CLE-FORGE Special Purpose Drills . . .

. . . produce 10 times more holes per grind . . . increase production 80% . . . double the number of holes per grind . . . cut cost per hole . . . eliminate breakage . . . speed production at no increase in tool cost . . . average 13,000 more holes per grind.

These are not "special" tools, but are stock drills at regular prices . . . available for immediate delivery.

For greatest economy, CLE-FORGE Special Purpose Drills can be ordered with tangs (at no extra cost) and used with CLEVELAND Split Sleeves. Instead of paying for a taper shank on every drill, you get the needed length with a CLEVELAND Split Sleeve—which outlasts many drills.

If you have a problem of high drilling costs, perhaps a CLEVELAND Service Representative can help you solve it with CLE-FORGE Special Purpose Drills. Contact our nearest Stockroom, or . . .

TELEPHONE YOUR INDUSTRIAL SUPPLY DISTRIBUTOR

for CLEVELAND Quality Tools . . . *prompt delivery from stock*

THE CLEVELAND TWIST DRILL CO.

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Stockrooms: New York • Atlanta • Cleveland • Detroit • Chicago • Dallas • Los Angeles • San Francisco

DECKEL *LK Machine Tool Series Brings You . . .*

Direct Numerical Readings To .0001"

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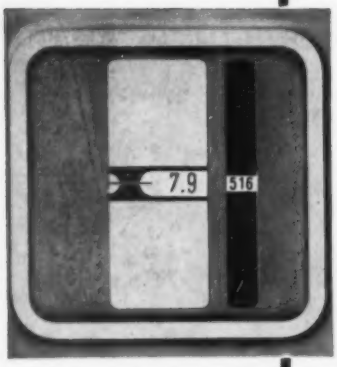
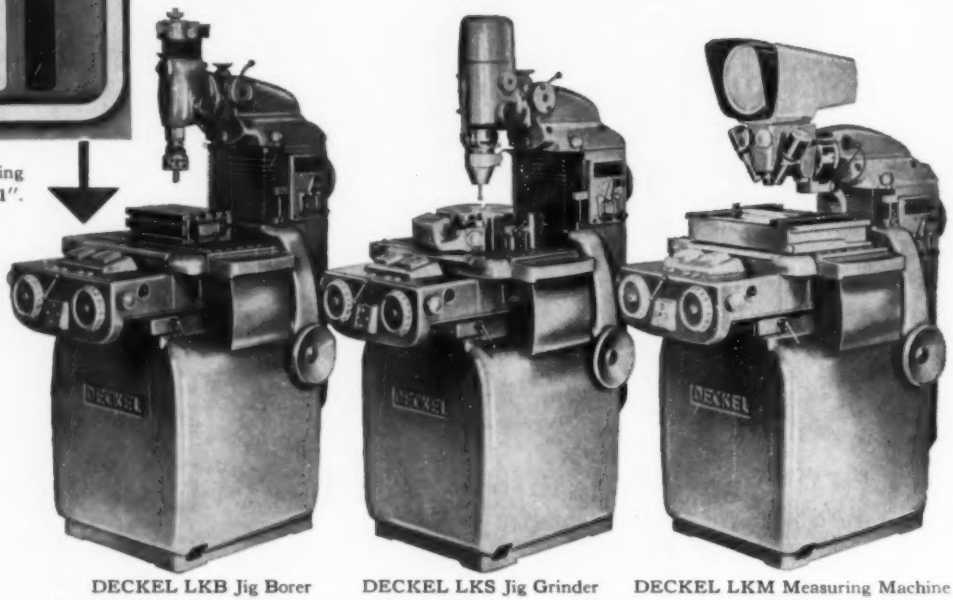
Optical Coordinate

Jig Boring | **Jig Grinding** | **Profile Measuring**



Projection screen showing scale readings to .0001".



DECKEL LKB Jig Borer
Worktable area: 25.6" x 11.8"

DECKEL LKS Jig Grinder
Worktable area: 25.6" x 11.8"

DECKEL LKM Measuring Machine
Magnification: 10X, 20X

This outstanding machine tool development couldn't be more timely. The new DECKEL LK series of optical coordinate machine tools combines economy with extreme precision—at a time when these two factors are highly critical.

Three Machines In One—Simple interchangeability of jig boring, jig grinding and profile measuring heads gives you a choice of one, two or three machines on one universal base. Change from one head to another takes only minutes. Used individually, each one of these machines will give you remarkable accuracy and performance.

Direct Numerical Readings—For the first time on any machine tool, coordinate table settings *can be read directly in numbers* to ten-thousandths (.0001") of an inch. No conversions or interpolations are needed. Reading errors are practically impossible. Actual positioning accuracy is within .00012".

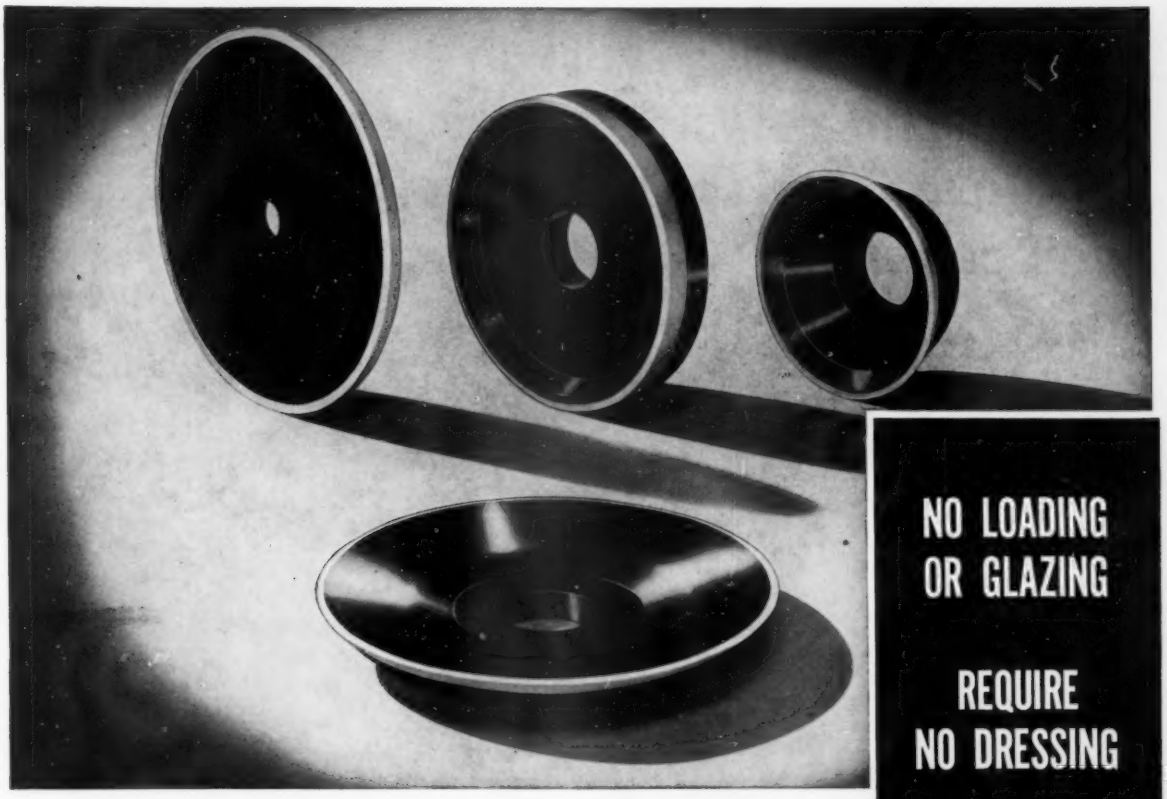
Thermal Expansion Compensation—The inherent accuracy of these machines is protected by a unique thermal expansion compensating device—built-in to the supporting bracket. Dissipation of heat from the gear box and drive motor provides additional thermal stability.

Write For Additional Information

COSA — *nationwide sales and service of precision machine tools —from bench lathes to boring mills.*

COSA CORPORATION, 405 LEXINGTON AVENUE, NEW YORK 17, N.Y.

IN CANADA contact COSA CORPORATION OF CANADA, LTD., 1160 Lakeshore Road, Long Branch, Toronto 14, Ontario



NO LOADING
OR GLAZING

REQUIRE
NO DRESSING

BONDED
FOR SPECIFIC
GRINDING
REQUIREMENTS

NATURAL
OR MAN-MADE
DIAMONDS

MANHATTAN DIAMOND WHEELS

CUT FASTER, COOLER . . . LONGER

Every Manhattan Diamond Wheel is specially *bonded* to assure precision grinding at top speed without loading or glazing. Resinoid bonded for tungsten carbide grinding, they cut cool and free with lightest pressure . . . eliminate danger or damage to heat-sensitive carbide. Special metal bonds give you the finish you want for glass, quartz and ceramics. They require no dressing — for either wet or dry grinding.

Manhattan Diamond Wheels give you faster, cooler cutting action *plus* higher wheel efficiency and longer life on the toughest jobs. Specify from Manhattan's wide variety of surface-contact shapes . . . in the diamond concentration and grit size best suited for your surface, cylindrical, or internal grinding operations. You get "More Use per Dollar" with Manhattan Diamond Wheels.

RM 947

GRINDING WHEEL INSTITUTE MEMBER

RM

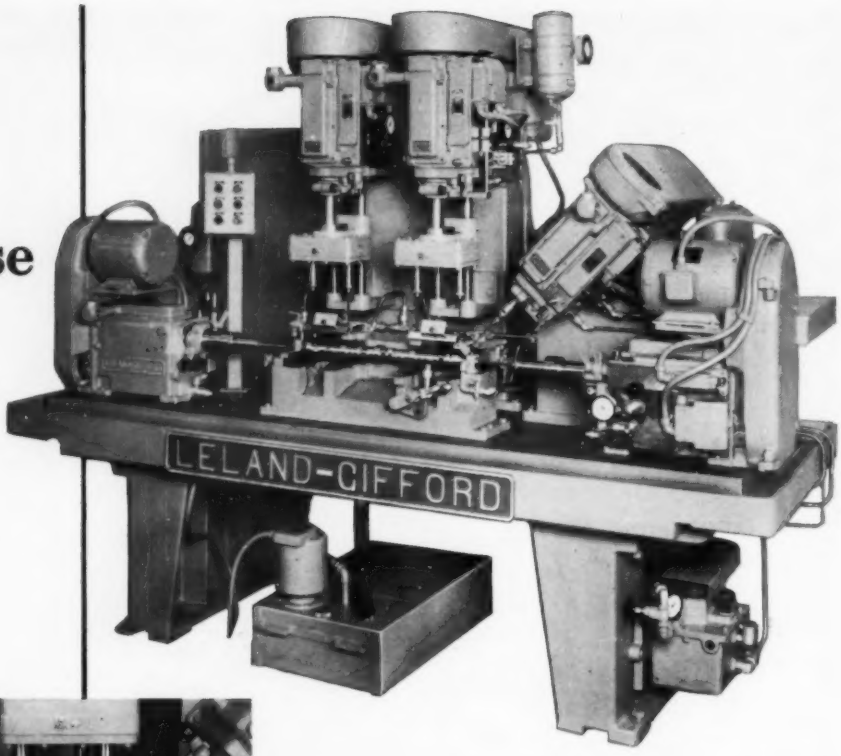
WRITE TO DIAMOND WHEEL DEPARTMENT

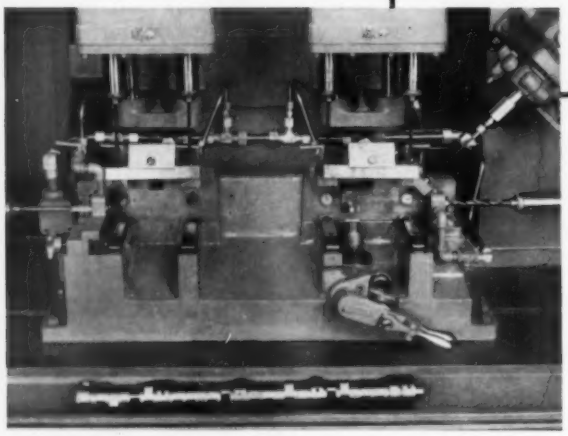
MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Belts • Hose • Roll Covering • Tank Linings • Industrial Rubber Specialties • Abrasive and Diamond Wheels • Brake Blocks and Linings • Clutch Facings • Asbestos Textiles • Mechanical Packings • Engineered Plastics • Sintered Metal Products • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

Here's an idea you can use to cut precision drilling costs....





One machine, one handling, one quick, simple operation does all the precision drilling on this camshaft. Note that this is not ordinary gang drilling — the job involves axial, angular and cross holes as well as reaming.

Leland-Gifford has time-saving, cost-cutting ideas for you, too — ways you can combine multiple operations into a simple, efficient unit operation.

THE JOB: Drill one end of camshaft and ream the other while drilling four cross holes and one angular oil hole.

THE MACHINE: A Leland-Gifford special with five No. 2 self-contained units and standard hydraulically clamped fixture interlocked with drilling units to start feed after clamping and to unclamp when operation is finished. SC units are interlocked to prevent interference between cross and axial drills. One operator completes 60 camshafts per hour at 100% efficiency.

For Automatic Drilling at its best be sure to see Leland-Gifford

CALL THE OFFICE NEAR YOU

LELAND-GIFFORD SPECIAL DRILLING MACHINES

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U. S. A.

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10429 W. McNichols Rd.
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MATTISON
HIGH-POWERED PRECISION
GRINDING METHODS

Mattison surface grinders outproduce cutter-type machining on parts like these

Stop Lever Bracket

MILL	GRIND
58 min	44 min

Table Guide

MILL	GRIND
12 min	4½ min

Roll Housing

MILL	GRIND
16 min	11 min

Motor Base Plate

PLAIN	GRIND
82 min	57 min

Lock Bar

MILL & GRIND	GRIND
44 min	24 min

Feed Control Plate

MILL & GRIND	GRIND
35 min	20 min

Table Guide

MILL	GRIND
16 min	9 min

Roll Housing

MILL	GRIND
17 min	11 min

CONTINUOUS CUTTING ACTION SAVES MONEY

These jobs show how high-powered surface grinders speed stock removal (up to ¼ in. per side is economical) . . . with improvements in finish and accuracy. Real savings come from reduction or elimination of: scrap, downtime for tool changing and sharpening, setup time, fixture costs, and tool breakage. Ask for a test grind of your parts in our Methods Lab.

MATTISON MACHINE WORKS
Rockford, Illinois Phone WOodland 2-5521

MATTISON MACHINE WORKS ROCKFORD ILLINOIS

HIGH-POWERED PRECISION SURFACE GRINDERS

USE READER SERVICE CARD, CIRCLE 142

GADGETS CONTEST

If you've thought up an interesting device that makes toolroom or production jobs easier, safer or more efficient, get it ready for the Gadgets Contest, beginning October 1.

Entries for the contest will contain ideas that are real practical value to tool engineers. They are ideas you won't find in any handbook, but they are valuable contributions to America's productive knowhow.

Take a look at the Gadgets in the Gadgets Section of any issue of THE TOOL ENGINEER. They are typical of the sort of idea we are talking about.

Then sharpen your pencil and get to work. Write a brief description of your Gadget, make a sketch and get your gadget ready to send along. You may win one of the seven cash prizes and you'll have the satisfaction of knowing that your idea may be real value to fellow tool engineers.

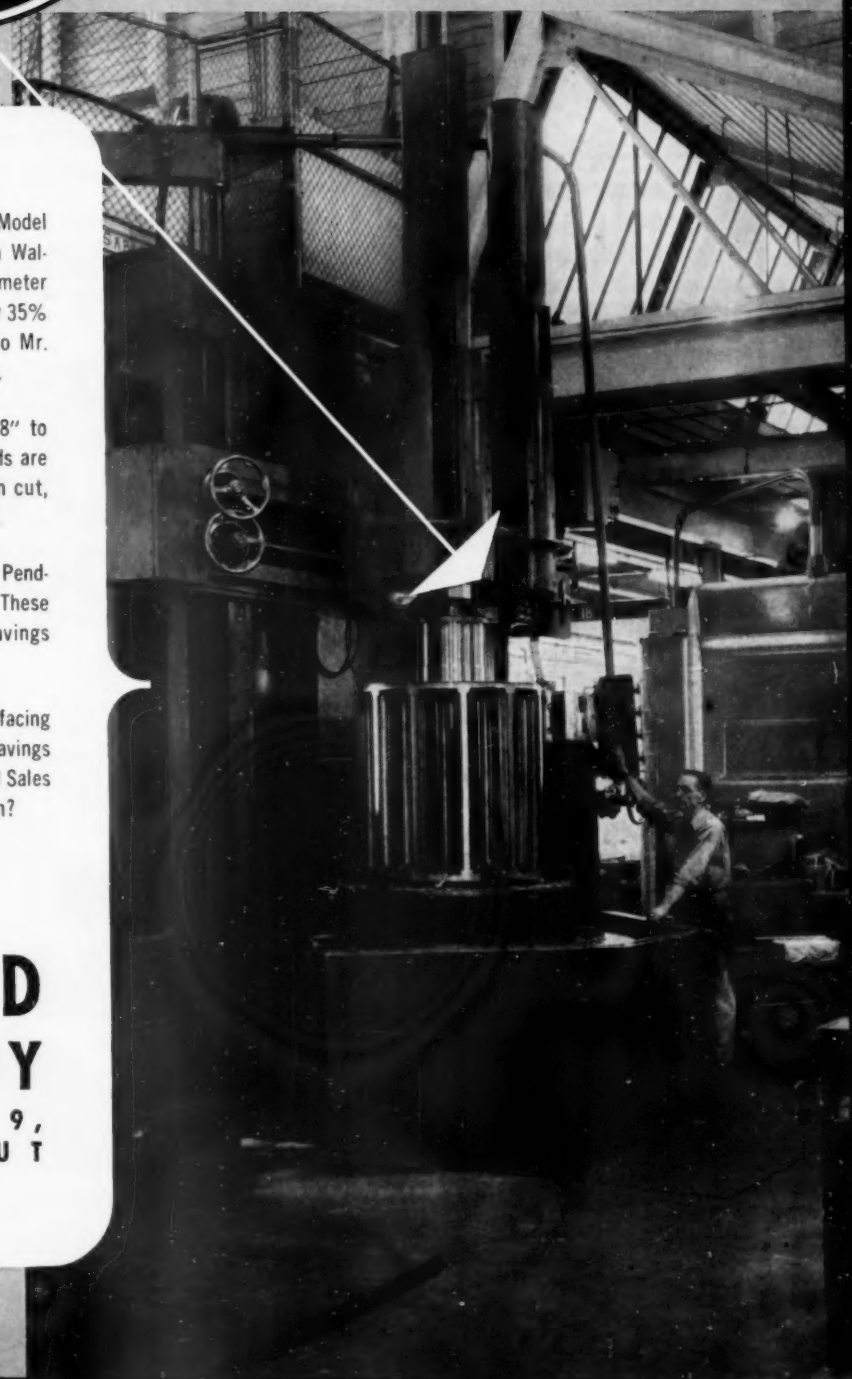
GADGETS CONTEST RULES

1. **ELIGIBILITY:** This contest is open to all members of the American Society of Tool Engineers.
2. **DEFINITION:** "Gadgets" are defined as tools or methods developed to solve specific production problems. They should contain a useful and practical idea or indicate an ingenious solution to a tool engineering problem.
3. **PRIZES:** One $100 first prize, two $50 second prizes, four $25 third prizes, and honorable mention awards which will be a choice of the Tool Engineers Handbook, 2d Edition, or Die Design Handbook published by the American Society of Tool Engineers. Certificates will be awarded to all prize winners.
4. **PERIOD:** The contest will run from October 1 until December 31, 1959. All contributions to the Gadgets Department received from ASTE members during the period of the contest will be considered as entries.
5. **JUDGING:** Entries will be judged on the basis of originality and usefulness to other tool engineers. Also, clarity of illustrations, conciseness and completeness of presentation will be considered. Members of the ASTE National Editorial Committee will serve as judges. Winners will be notified by mail as soon as possible after completion of judging. A list of winners will be published in THE TOOL ENGINEER.
6. **ENTRIES:** The name and chapter affiliation of the author should be written on each page of the entry. No entries will be returned. Information which has been published previously in a periodical or national magazine is not eligible. All publication rights are assigned to THE TOOL ENGINEER. Authors of entries published in THE TOOL ENGINEER will receive honorariums.
7. **LENGTH:** Entries should be limited to 500 words or less. Sketches or photographs should be used to illustrate the methods or devices described in the text of the entry.
8. **MAIL ENTRIES TO:** Gadgets Contest Editor, THE TOOL ENGINEER, 10700 Puritan Ave., Detroit 38, Mich.

USE READER SERVICE CARD, CIRCLE 144

35% Faster with a CUT MASTER Model 75

BULLARD



With their new 76" Bullard Cut Master, Model 75, the Bird Machine Company, South Walpole, Mass., is machining a 39-5/8" diameter stainless steel cylinder frame assembly 35% faster than previously, according to Mr. James Lindsay, General Superintendent.

For the rough cut, removing from 1/8" to 3/16" of stock, the ram and side heads are cutting simultaneously. On the finish cut, .005" deep, only the side head is used.

Accuracy to hold size reduces spoilage. Pendant control reduces operator fatigue. These factors contribute to make these savings possible.

An analysis of your turning, boring, facing and threading operations may show a savings over your present method. Your Bullard Sales Engineer can tell you. Why not ask him?

Or, write

THE BULLARD COMPANY
BRIDGEPORT 9, CONNECTICUT

For Highest Precision and Dependability

CARL ZEISS JENA

LARGE TOOLMAKER MICROSCOPE

6" x 2" RANGE
11" Diameter Built-in Rotary Table
Indexing Full 360°

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NEW PRECISION HOLE GAGE

Requires no "Masters" Rings or Setting Blocks

MECHANICAL
RUGGED
PORTABLE

FREE!
Bul. # SSC-B1
Write for your copy

- Range .370" to 1.510"
- Calibrated to .000010" accuracy
- Sets any hole size to .000025"
- .005" direct-reading linear scale
- Priced to fit your budget

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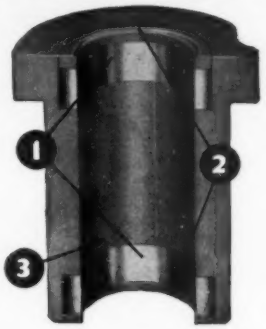
CARBIDE INSERTED MEYCO BUSHINGS Can Cut Production Costs!

MEYCO carbide inserted drill jig bushings have been successfully saving money on production runs for the past decade. Performance: same as solid carbide, but need not be handled with kid gloves. Greater economy, because of long life at less cost. You can enjoy the advantages of greater accuracy for a longer time, less spoilage, less machine down-time, added drill and jig life with MEYCO carbide inserted drill jig bushings. Get the full story now: write for new Bushing Catalog No. 42.



*PATENTED

1. Tungsten carbide rings at the points of wear; 2. Steel rings protect drills and carbide; 3. Special hardened alloy steel body.

W. F. MEYERS CO., INC., BEDFORD, IND.

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ACCURACY .0002 T.I.R.

.0002 T.I.R. or less at Spindle Nose, .0005 T.I.R. or less on Test Arbor six inches from Spindle Nose

SPINDLE SPEEDS 150 and 250 RPM Other Spindle Speed Pulleys Available

MODEL B943 MOTOR DRIVEN WORK HEAD

No. 11 B & S Tapered Spindle Standard Equipment. No. 12 B & S or No. 5 Morse Available at Slight Extra Cost.

Clip ad to your letterhead and send for Literature

K. O. Lee Company, Aberdeen, S. D.

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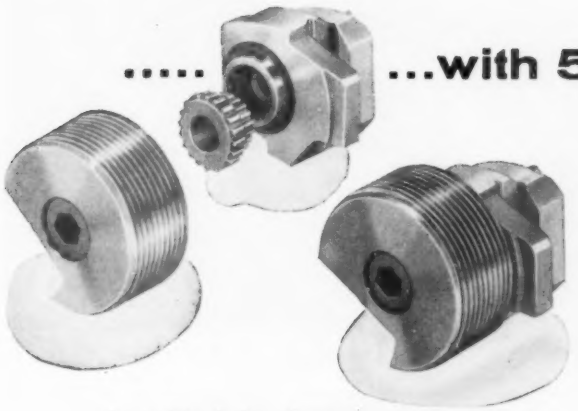
IMPROVE THREAD QUALITY AT COST SAVINGS YOU CAN MEASURE

....with 5 chaser Vers-O-Tools



Available from stock in sizes from $13/16$" to $3\,1/2$"

The superiority of Vers-O-Tool automatic die heads has been proven in thousands of applications. Basic design simplicity, unsurpassed economies in chaser grinding and precise relocation of chasers without re-adjustment . . . all have contributed to better threaded pieces at lower cost.

Now with 5 chaser heads available in a complete range of sizes . . . *add up these conclusive facts—and prove it to yourself!*

Write for complete information

- Elimination of out of round and drunken threads
- Chasers can be ground closer to center, resulting in smoother, more accurate threads
- 5 Chasers lighten the chip load on each tool
- Longer chaser life per grind—less machine down time
- 5 Chasers permit threading of parts with flats, slots, keyways, etc.

National Acme

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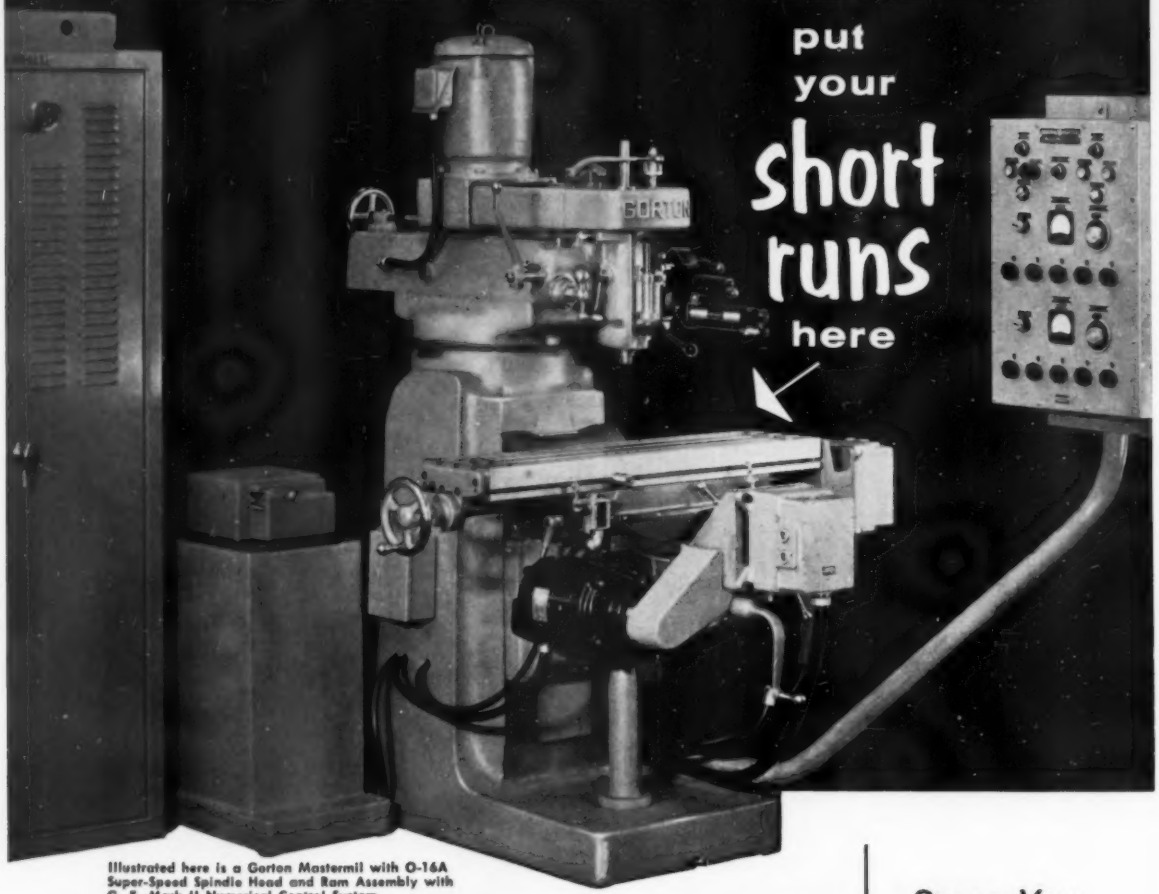
19[illegible] East 131st Street
Cleveland 8, Ohio

Sales Offices: Newark 2, N. J., Chicago 6, Ill., Detroit 27, Mich.

FOR NUMERICAL CONTROL AT LOWEST COST



Illustrated here is a Gorton Mastermil with O-16A Super-Speed Spindle Head and Ram Assembly with G. E. Mark II Numerical Control System

GORTON NUMERICAL CONTROL

is field tested and proved in use

This is how Gorton Numerical Control saves you money on short runs:

- — eliminates elaborate and costly tools, dies, jigs and fixtures
- — wastes no time because operator does not "pace" the work
- — makes no mistakes because operator skill not required
- — extreme, repetitive accuracy is easy and automatic
- — change overs in set-ups can be made quickly
- — signals operator when tool changes are needed
- — guides cutter in close quarters without damage to work or cutter
- — making punched tape is simple typewriter operation

Punched tape . . . or magnetic tape control . . . is available to you on SIX standard Gorton machines and also on Gorton custom-designed machines. You'll be agreeably surprised when you learn the low cost of Gorton Numerical Control and how much more it gives you for your money. For full information write

Saves You Money on —

- face milling
- side milling
- end milling
- straight line cavity milling
- slotting
- drilling
- reaming and boring

Your letterhead inquiry will receive prompt attention.

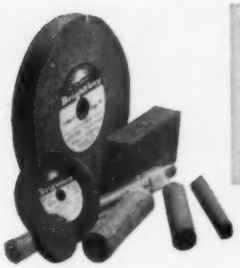
GORTON

SINCE 1893

GEORGE GORTON MACHINE CO.

2610 Racine St. • Racine, Wisconsin

Tracer-Controlled Pantographs, Duplicators — standard and special . . . Horizontal and Vertical Mills, Swiss-Type Screw Machines, Tool Grinders, Small Tools and Accessories.



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Broaden Your Abrasive Opportunities
Improve Your Product Quality

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Many new applications replacing costlier methods. *Unique action:* BURRING, FINISHING • CLEANING • POLISHING, frequently in one operation. STOCK NUMBERS for machine and manual operations, JOB-MATCHED TO YOUR REQUIREMENTS. *Order from your Brightboy distributor's stock, backed up by our complete factory stock.*

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WELDON ROBERTS RUBBER CO.
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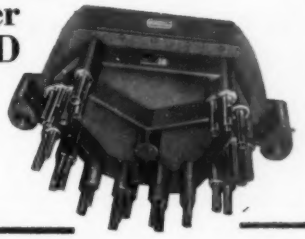
WELDON ROBERTS
Brightboy
RUBBER CUSHIONED ABRASIVES

USE READER SERVICE CARD, CIRCLE 151

This THRIFTMASTER Fixed Center DRILLHEAD *does 27 jobs in 1 fast operation!*



Get maximum production—use Thriftmaster designed and built Fixed Center Drillheads. . . .

- **Full ball bearing construction**
- **Fully hardened chrome-moly steel gears, spindles and drives**
- **All sizes, any number of spindles**
- **All types, including angular, rotating and lead screw**
- **For drilling, tapping, reaming, boring and milling**
- **Guaranteed performance backed by over 25 years of engineering and production experience**

Also Full Ball Bearing Universal Joint, Single and Double Eccentric Adjustable Drillheads and Dorman Tappers.

Write, wire or phone for complete information today.

THRIFTMASTER
Products Corporation
A SUBSIDIARY OF THOMSON INDUSTRIES, INC.

1004 N. Plum Street
Lancaster, Pennsylvania

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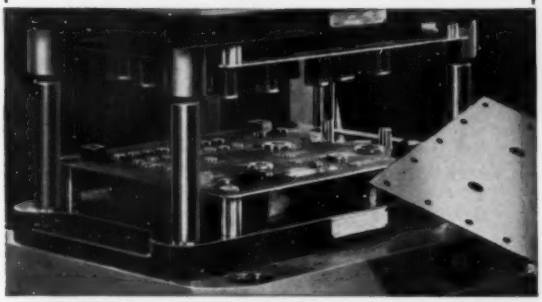
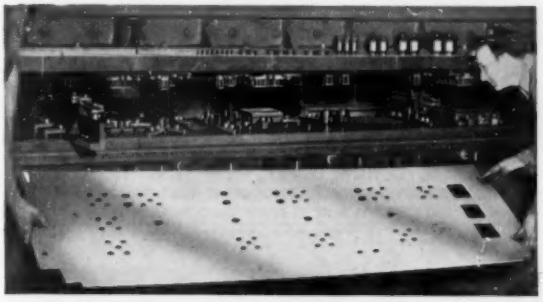
OVER 2700 PLANTS are saving money with WHISTLER DIES



MAGNETIC PERFORATING DIES

All parts reusable and interchangeable. Punches and dies stocked in .001" increments from .100" thru .500" dia. Larger sizes available.



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All parts reusable and interchangeable. Punches and dies stocked in .001" increments from .100" thru .500" dia. Larger sizes available.

manufacturer of all types of CUSTOM DIES for over 40 years

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Mail the following: ☐ **Magna-Die Catalog** ☐ **Adjustable Die Catalog**
☐ **More information on custom die work**

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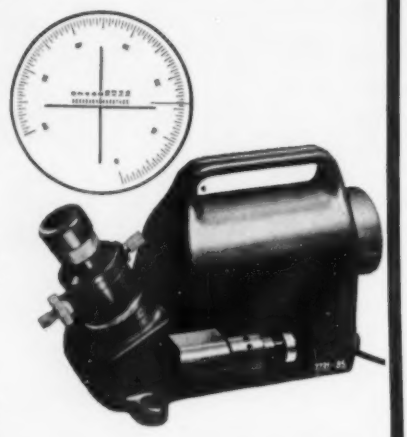
Leitz The NEW Concept in AUTO-COLLIMATORS

- For testing angular deviations within tolerances of 1/10 second of arc.
- Short and compact design of 13" overall length.
- Measurements in 2 planes obtained by merely rotating eyepiece against positive stops.
- Range of focus 0-50 feet.

Request circular 85-200



OPTO-METRIC TOOLS, INC.

137 TE VARICK STREET, NEW YORK 13, N. Y.

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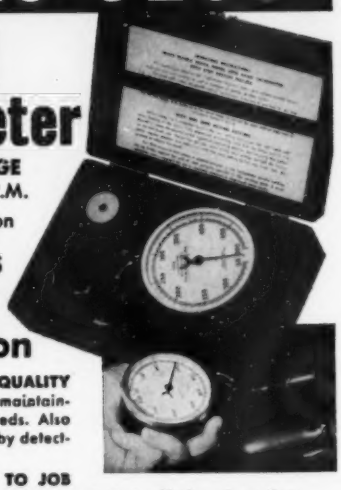
JONES #3200 Hand Tachometer

BROAD RANGE
50 — 5,000 R.P.M.
with stop button

assures better production



HIGHER OUTPUT — QUALITY CONTROL obtained by maintaining proper machine speeds. Also helps avoid breakdowns by detecting irregularities.

CARRY IT FROM JOB TO JOB and keep it handy for quick, accurate tests. Choice of readings in R.P.M., F.P.M., etc.

GUARANTEED ACCURACY—superior construction, trouble-free. Unaffected by moisture, temperatures, electric currents.

Many other Portable and Stationary Models, indicating Speeds between 50 R.P.M. and 50,000 R.P.M., are available.

Write for catalog 147-D

JONES MOTROLA CORP.
Stamford, Conn.

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Designed for use with Impact Wrenches

TITAN "Bull Dog" STUD DRIVER

Built for rugged use required in locomotive shops, plants building heavy equipment such as engines, air compressors, etc.

Equipped with special Titan Design Loose Pressure Plunger. Definitely stands up under vibration encountered when using an impact wrench for motive power. Loose Pressure Plunger affords much easier release from stud after it is driven and tends to prevent pulling the stud back out of the casting.

Accommodates stud diameters from ¼" to 3". Female driving squares from ½" to 1½". Morse Taper and Hex Slip Shanks can be furnished to adapt the tool to motive power other than impact wrenches.

WRITE for complete information, TODAY!

TITAN TOOLS — World's Largest Producers Of Stud Drivers And Pullers

TITAN TOOL CO.

44 MAIN ST., FAIRVIEW (ERIE COUNTY), PA.

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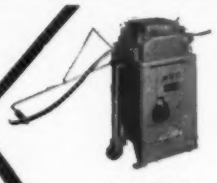
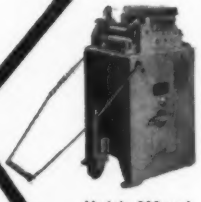
LITTELL COIL STOCK STRAIGHTENERS

The trim look of these Littell Straighteners is widely copied, but not their performance! They take the curve out of coil stock with efficiency that only Littell engineering experience can assure.
Straighteners shown handle stock .010" to .125" thick, up to 12" wide. Variable speed drives. Electric Clutch and Brake Models. Hydraulic Drive models.



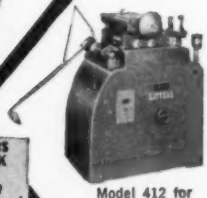
Model 208 for thin stock and parts to 8" wide, .010" to .040" thick.



Models 308 and 312 for stock 1" to 12" wide, .018" to .065" thick.

Write for Catalog "C"

Today's order ships tomorrow!



Model 412 for stock up to 12" wide, .040" to .125" thick.

F. J. LITTELL MACHINE CO. — SERVING USERS OF COIL STOCK
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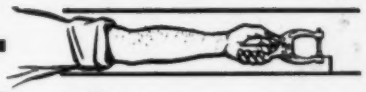
USE READER SERVICE CARD, CIRCLE 157

USE READER SERVICE CARD, CIRCLE 158

NEW 2-WAY
TRIGGER RELEASE
Model 462 illustrates how only one hand easily releases clamp by pressing trigger toward either handle. This patented feature available on many De-Sta-Co Portables.

IF YOU CAN REACH IT—



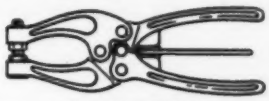
A DE-STA-CO Portable Will Clamp It!

Hundreds—yes, thousands—of awkward clamping problems have been brought to us for solution in our 40 years of leadership. Many of these have been solved by De-Sta-Co Portable Clamps. You now have a selection of two dozen basic models, a variety which masters almost any conceivable portable, blind or awkward clamping operation. To add to the versatility of all our portables, there's a complete line of accessories. Features which may aid you in your next problem are

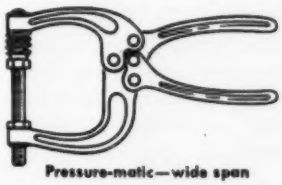
1. ***Two way trigger releases*** **on numerous models**
2. ***Deep jaws and wide spans***
3. ***Flexi-matic and Pressure-matic spindle adjustments***
4. ***Non-magnetic materials*** **for the special application**
5. ***Light weight models*** **for continuous frequent handling**

Compact models

Self-adjusting models



Deep jaw models



Pressure-matic—wide span

De-Sta-Co Portables lend themselves to special adaptations for that "insurmountable" problem.

Standard portables offer jaw openings ½″ to 6″, throat depths to 3½″, pressures from 35 lb. to 1200 lb.

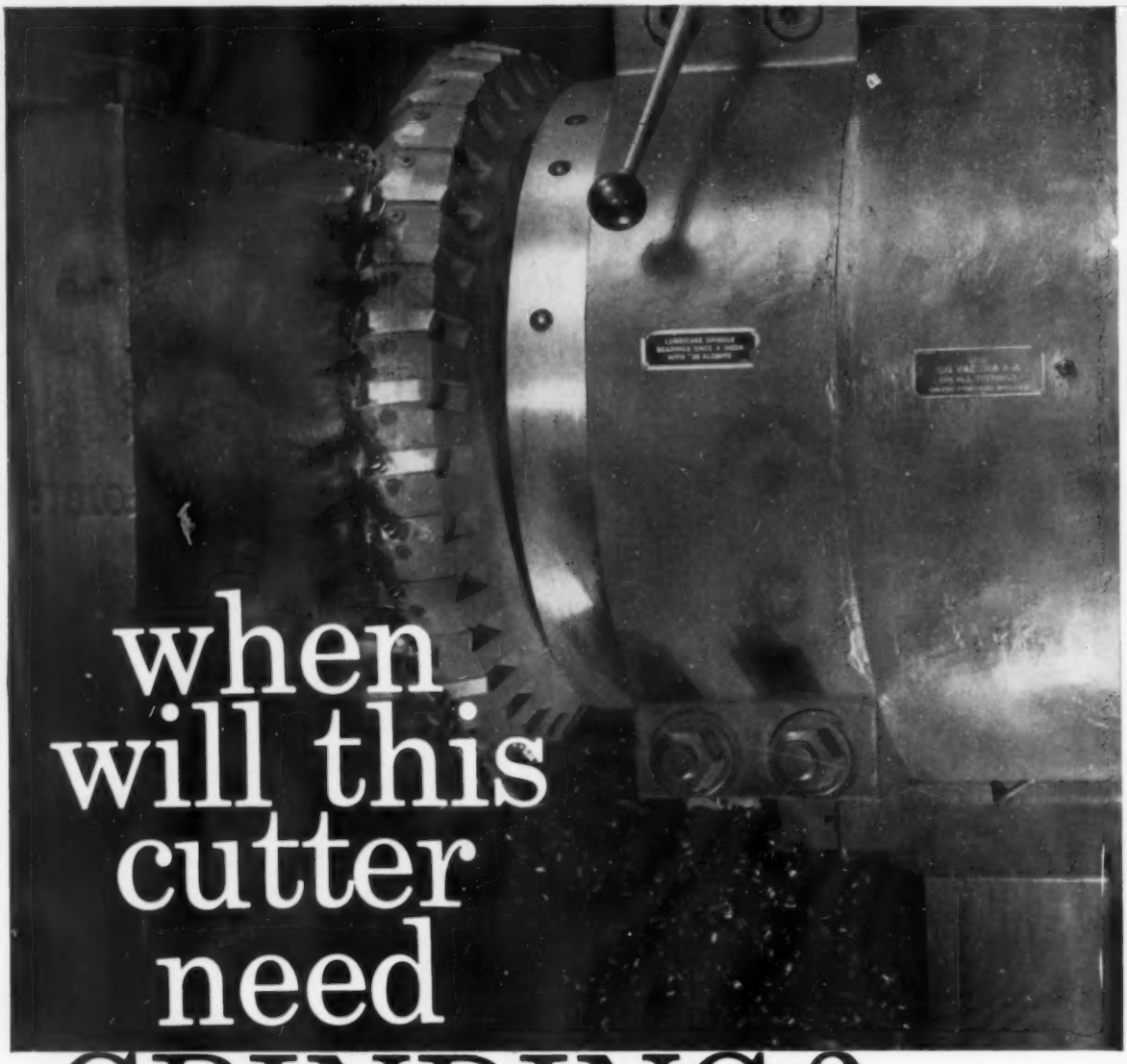
Send for the De-Sta-Co catalog with details on over 130 types, sizes and models of portable and *fixture* clamps. We'll send you the name of our stocking distributor in your area. He is ready and qualified to assist you with your clamping problem.

De-Sta-Co is widely known for toggle clamps, stampings, precision washers, spacers, shims, shim and feeler stock, blower housings and marine specialties.

DE-STA-CO

DETROIT STAMPING COMPANY

328 MIDLAND AVENUE • DETROIT 3, MICHIGAN



when will this cutter need GRINDING?

When the blades get dull, of course.

But when is a cutter blade dull? At what degree of dullness does it begin to consume increasingly more horsepower and produce inferior finish? At what point does grinding prolong blade life?

Knowing *exactly* when to grind cutters is just one of the many variables that vitally affect performance and costs.

Our specialty is working with these variables—to furnish the most economical solutions to milling and boring problems, including grinding techniques, through the use of inserted blade cutters.

We study machine, work piece, feed rate, depth of cut, speed and finish requirements. And only after pooling this information with the customer's specialized knowledge of his own work is any cutter recommended.

We would appreciate the opportunity to tell you more about this unique cutter selection service. Write:

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REDUCE THE COST OF CHIPS

This helpful new booklet tells you how to reduce the cost of chips and improve your milling and boring performance. Ask for a free copy of booklet No. 58F.

THE
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MILLING MACHINE COMPANY
CUTTER DIVISION
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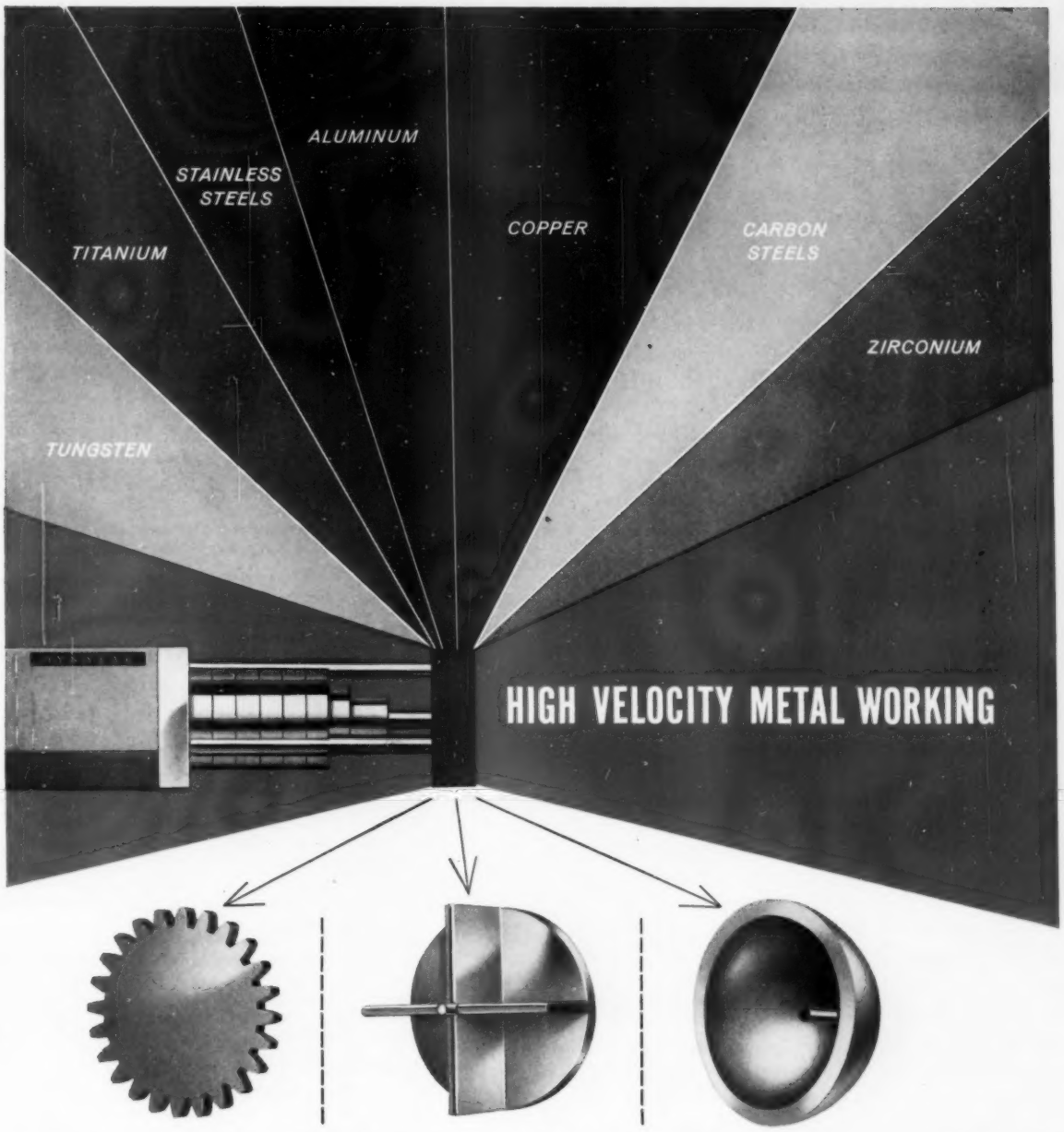

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The ability of DYNAPAK high velocity metal working machine tools to forge, form or extrude intricate shapes to precision tolerances from common or high strength metals, offers new solutions for complex problems of design and manufacture.

THE DESIGN ENGINEER will find a new degree of freedom in design. He is no longer confined by the limitations of conventional forming techniques. He can now more nearly specify the ideal materials, shapes, and tolerances.

THE PRODUCTION ENGINEER can often accomplish, in a single operation and with simplified tooling, what would otherwise require multiple operations and complex tooling. With DYNAPAK, management can realize a substantial long-term advantage in capital investment.

Arrange today to evaluate DYNAPAK for your metal working operations. Write, wire or phone

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- diameters
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DoALL has the instruments and equipment to help you solve your problems quickly and economically. And DoALL has the long experience necessary to advise you as to proper procedures, methods, results. This service by factory-trained specialists is free.

DoALL precision measuring and inspection equipment is carried in stock—ready for immediate delivery—in your nearby DoALL Store. Here's one reliable source . . . one responsibility . . . for more than 1500 top-quality products. This large local inventory is backed by a $2,000,000 central warehouse stock—connected to each DoAll Store by Teletype for prompt service.

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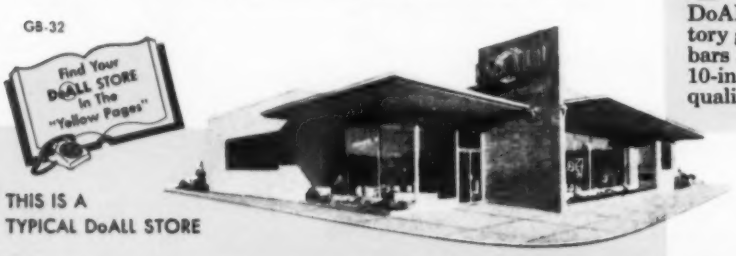
In addition to the free services of its dimensional quality control specialists, your nearby DoALL Store offers many educational aids. These aids include: "Height Combination Tables," "Heat Expansion Calculator," "The Facts of Gage Block Life," "Fringe Line Pattern Wall Chart" and others. Ask your DoALL specialist for copies.

COMPLETE CALIBRATION SERVICE

DoALL gage block users and owners of other gage blocks can have their blocks recalibrated by DoALL's laboratory technicians. Inspection and calibration services are also available for thread, cylindrical, plug and ring gages.

GB-32



THIS IS A TYPICAL DoALL STORE

[1] GAGE BLOCKS AND ACCESSORIES

Accuracy begins with fine gage blocks. Get the best. DoALL gage blocks offer the utmost in accuracy—with tolerances that meet or exceed N.B.S. requirements. What's more, you get the finest finish in the industry, patented "Burr Proofing," special processing to guarantee stability. DoALL offers a complete line—21 sets, 5 to 121 pieces—in rectangular and square styles. AA, A+ and A grades.

NEW! 56-PIECE SET. A new, practical set for shop use gives more useful dimensions with fewer blocks . . . saves time in setups, inspection.

MICRO-STEP GAGES. Quickly assembled with rectangular blocks and special holders. Result: an unlimited number of different, accurate gages for inside and outside measurement.

[2] LAYOUT AND INSPECTION EQUIPMENT

DoALL black granite products go far beyond usual tolerances—beyond federal specifications. Manufactured to *Unilateral Tolerance Limits*. DoALL now delivers *twice* the accuracy for the same money or less.

DoALL black granite surface plates are made in 432 sizes, ledges, accuracies. Also available: angle plates, straightedges, parallels, master flats, magnetic chuck platforms, plate stands . . . and a complete line of metal plates, straightedges, accessories.

[3] COMPARATIVE MEASUREMENT

DoALL offers a complete line of the finest electronic, mechanical and optical comparators—answering every need in laboratory, toolroom, shop and inspection departments. DoALL electronic comparators measure in millionths!

[4] SHOP INSPECTION GAGES

At your local DoALL Store—complete lines of micrometers; calipers; thickness gages; dial indicators; snap gages; thread ring, cylindrical plug gages; many other types. Highest quality always.

[5] OPTICAL INSTRUMENTS

All DoALL Stores feature the complete line of Bausch & Lomb Stereo-Zoom microscopes, toolmaker's microscopes, readers, magnifiers. And for utmost precision in optical production measurement control—the B & L Contour Measuring Projector.

[6] LIGHT WAVE MEASUREMENT

DoALL monochromatic lights, using a helium light source, and optical flats are necessary for inspection by interferometry. "Monolights" are portable, made in two sizes. DoALL optical flats of pure, fused Brazilian quartz—made in round and square styles.

[7] SURFACE FINISH GAGES

Surface roughness scales and specimens aid in specifying and inspecting both flat and cylindrical surfaces. Flat scales show 13 representative surfaces. Cylindrical scales—available in internal-external and turned-bored styles. Specimen sets show 25 types of surfaces on ten blocks.

[8] ANGLE MEASUREMENT

DoALL sine bars and plates are produced to laboratory grade standards—within N.B.S. tolerances. Sine bars are 5 in. long. Sine plates—available in 5- and 10-in. sizes. Universal bevel protractors offer highest quality. Range: 0-90° through 360°.

THE DoALL COMPANY

MEASURING and INSPECTION EQUIPMENT

DES PLAINES, ILLINOIS

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MACHINES WITHOUT CUTTERS AGIETRON

SPARK EROSION MACHINE TOOLS

AGIETRON SPARK ERODERS are HIGH PRECISION MACHINE TOOLS, functionally designed and rigidly constructed for the highest tool room standards.

For special tools, dies or parts of such shape that ordinary Machine Tools cannot produce, or where the material is "IMPOSSIBLE", the AGIETRON is the solution.

With High Energy, Electronically-produced and CONTROLLED electrical discharges, the AGIETRON can work through SOLID CARBIDES and the "EXOTIC METALS" to accuracies of **0.00005" • 50 MILLIONTHS OF AN INCH.**

AGIETRON IS THE LEADER IN SPARK EROSION MACHINE TOOLS as evidenced by . . .

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- **GENERATORS FROM 0.5 to 12KW**
- **STANDARD OR OPTICAL COORDINATE TABLES**

Servo-controlled feed up, down, longitudinally and rotationally . . .

BUILT BY ONE OF THE WORLD'S LEADING MACHINE TOOL BUILDERS . . . DEDICATED ONLY TO SPARK EROSION MACHINE TOOLS.

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we can't promise you the moon, **BUT**

Are you fed up with claims that a certain product will "cut costs" . . . "boost production" . . . "raise operating efficiency" . . . "increase your profits" . . . in short, are you being offered the moon but find yourself left on the launching pad?

Then you'll want to consider SIMONDS HIGH SPEED STEEL METAL CUTTING BAND SAW BLADE. Here's a blade that actually will do what you want it to in terms of square inches of cutting per hour, per blade . . . in terms of resistance to wear and breakage . . . in savings in downtime for blade changing.

Here's a HIGH SPEED STEEL BLADE we know will measure up to your expectations because (1) it's designed and engineered like a fine cutting tool; it's heat treated by newly developed techniques that produce maximum tooth hardness without damaging the cutting points while maintaining the toughness and flexibility of the back; and it's flex-tested to insure trouble-free on-the-job performance including the weld and (2) report after report from tests and production cutting in large plants in many industries verify that here, at last, is a HIGH SPEED STEEL band saw blade that really works.

We can't (and don't) promise you the moon, BUT we do offer you a saw for production cutting off that will withstand high speeds and heavy feeds and give you straight, accurate cuts with a fine finish. Put a SIMONDS HIGH SPEED STEEL SAW to work for you and find out how much better it really is. Call your Simonds Distributor.

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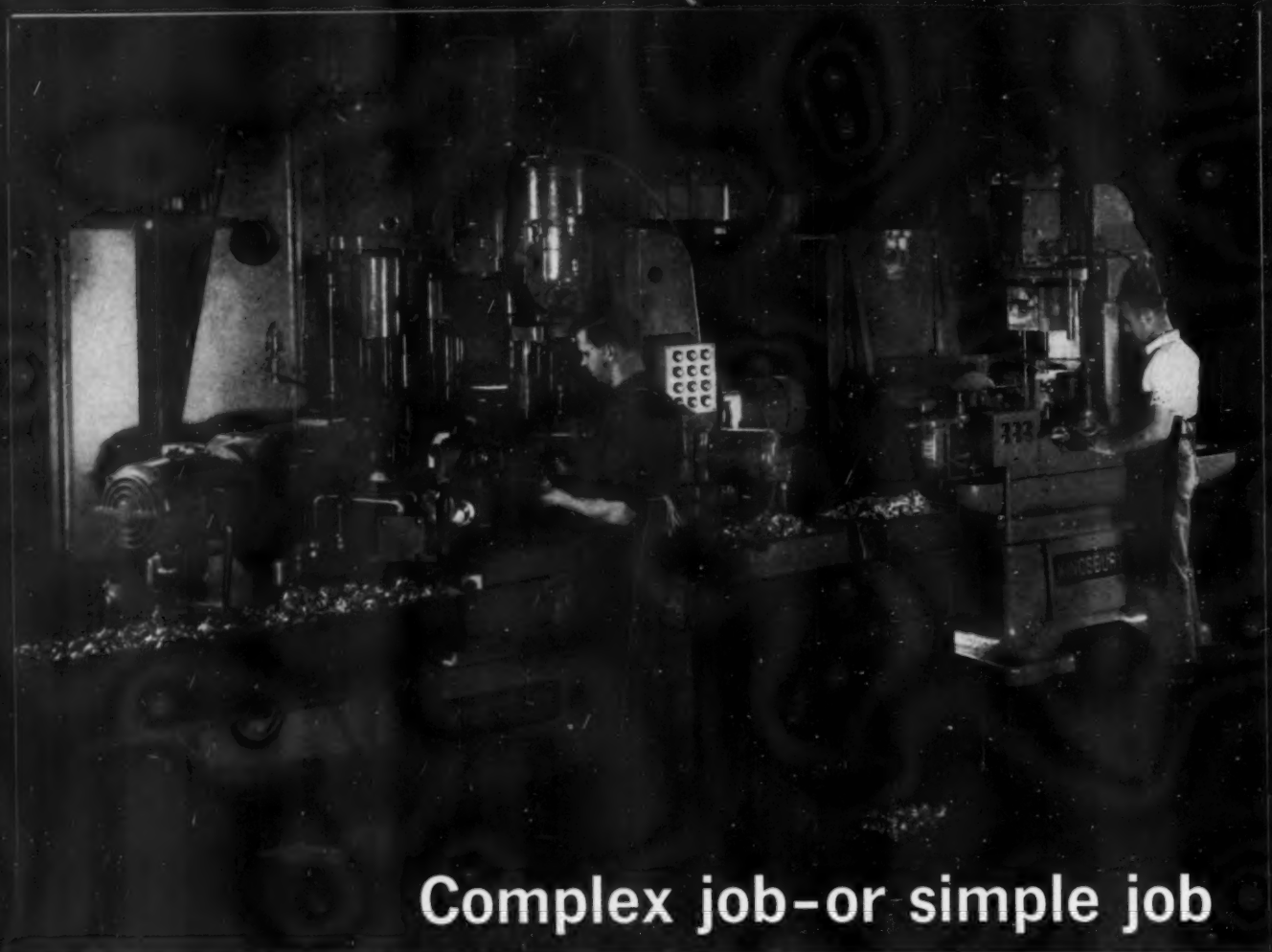


Complex job–or simple job

Kingsburys save money on both

600 valve castings per hour gross with a 14-spindle indexing machine

At the left is high production with a variety of tools — five combination tools, two drills, a hollow mill, a recessing tool for the undercut, a counterbore and three taps.

A 30-inch index table holds seven fixtures. Steel jaws in each fixture hold two parts, one in front for the first chucking and one in back for the second. A spring-loaded ram clamps the parts and an air cylinder unclamps them.

Nine self-contained units perform the operations. Seven have single spindles. Two vertical units have multi-spindle heads; each operates at two stations and in both chuckings.

The machine also handles a part with another tapped hole. The units cycle in 4.5 seconds, and the table indexes in 1.5 seconds, so a part can be finished every 6 seconds.

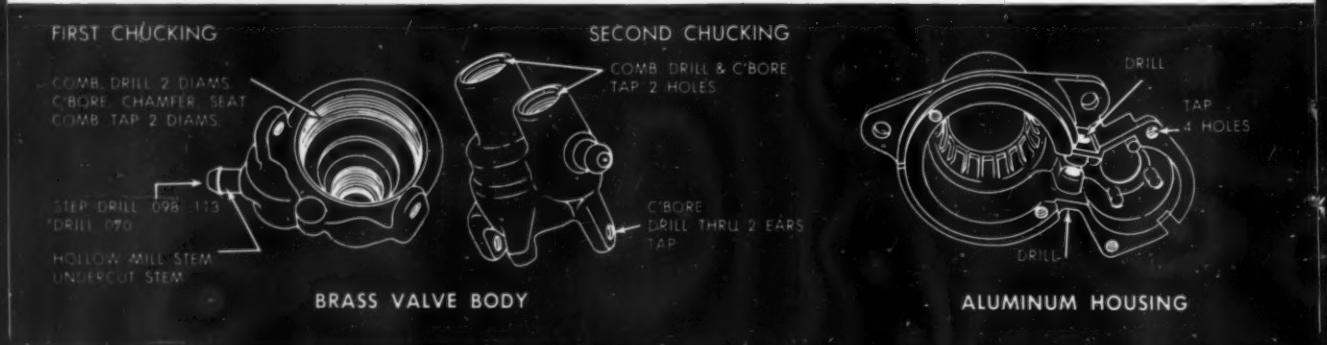
325 aluminum housings per hour gross with a 6-spindle non-index machine

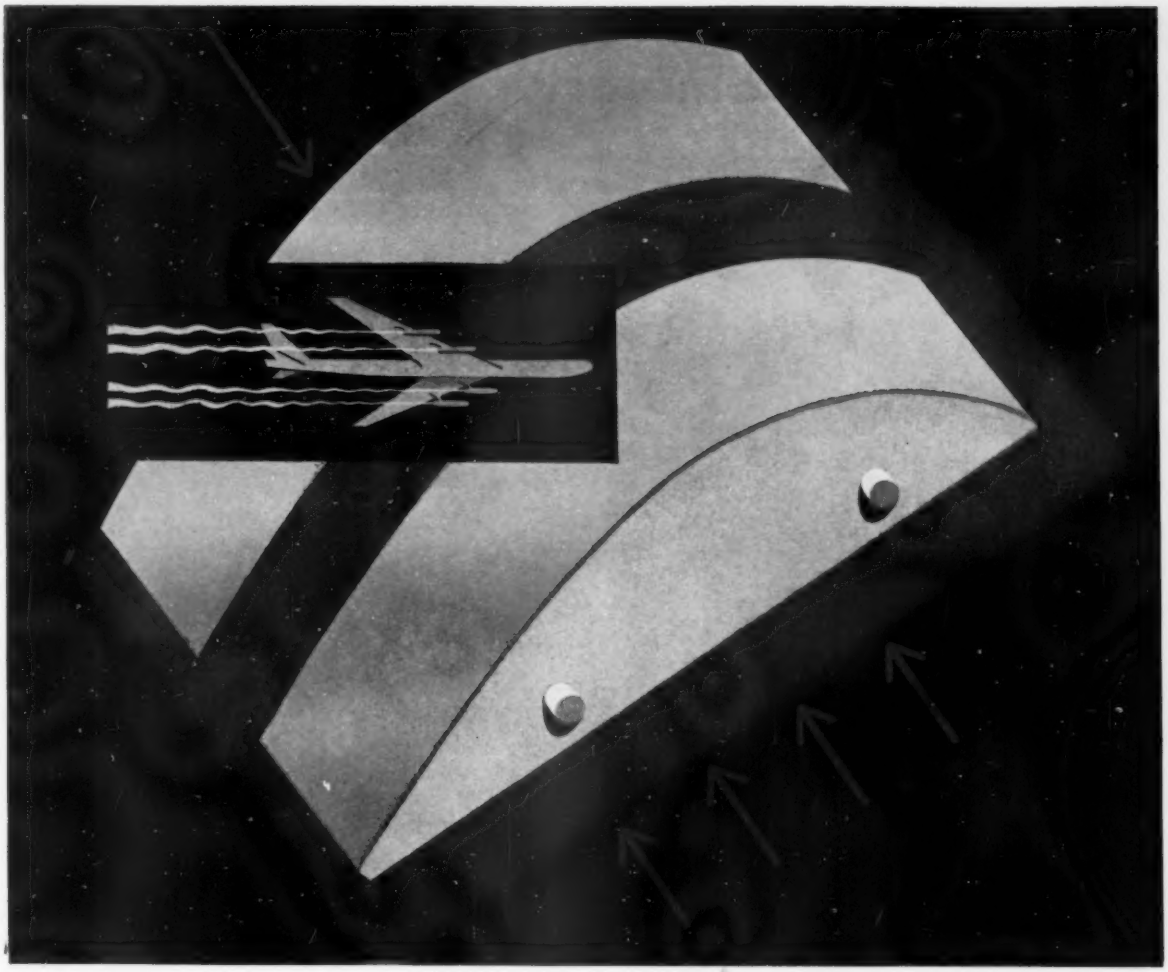
The machine at the right has one fixture. Clamping is manual. Two opposed units drill two holes in line. To avoid tool clash one unit cycles, then a cam-controlled valve trips the other. A vertical unit taps four holes.

Kingsbury machines save money because they produce uniform parts that gage. Good basic design and rugged accurate construction mean few rejects and little down time.

Kingsbury Machine Tool Corporation, Keene, N. H.

KINGSBURY MULTI-UNIT AUTOMATICS





Save up to 30% in cost, 60% in time with EPON® RESIN tools and dies

Your tooling resin formulator will show you how Epon resin formulations save time and money in applications such as these:

High temperature tooling: Metal forming stretch dies that can operate at temperatures over 400°F.

Heated tools: Matched dies, with integral heating units, may be made with Epon resin formulations for rapid heat curing of laminated plastic parts.

Long-lasting metal forming tools: Castings made of formulated Epon resin, mounted in a crank press, showed no permanent deformation after 28,000 compression-shock cycles.

In addition, Epon resin formulations offer you the following advantages:

Excellent tolerance control: Little machining and handwork are required to finish Epon resin tools because of the material's excellent dimensional stability and lack of shrinkage.

Outstanding strength: Jigs and fixtures with thin cross sections can be built from Epon resin-based formulations rejnforced with glass cloth. The resulting laminate has high flexural strength and excellent dimensional stability.

Easy modification: Tools and fixtures made from Epon resins may be quickly and easily modified to incorporate design changes.

CONTACT YOUR TOOLING RESIN FORMULATOR

The combination of resin formulator's skill and practical knowledge, backed by Shell Chemical's technical research and experience, has solved many important tooling problems for industry. Your own formulator specialist can help you solve yours. For a list of experienced tooling resin formulators and additional technical information, write to:

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PLASTICS AND RESINS DIVISION
50 WEST 50th STREET, NEW YORK 20, NEW YORK
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SHELL

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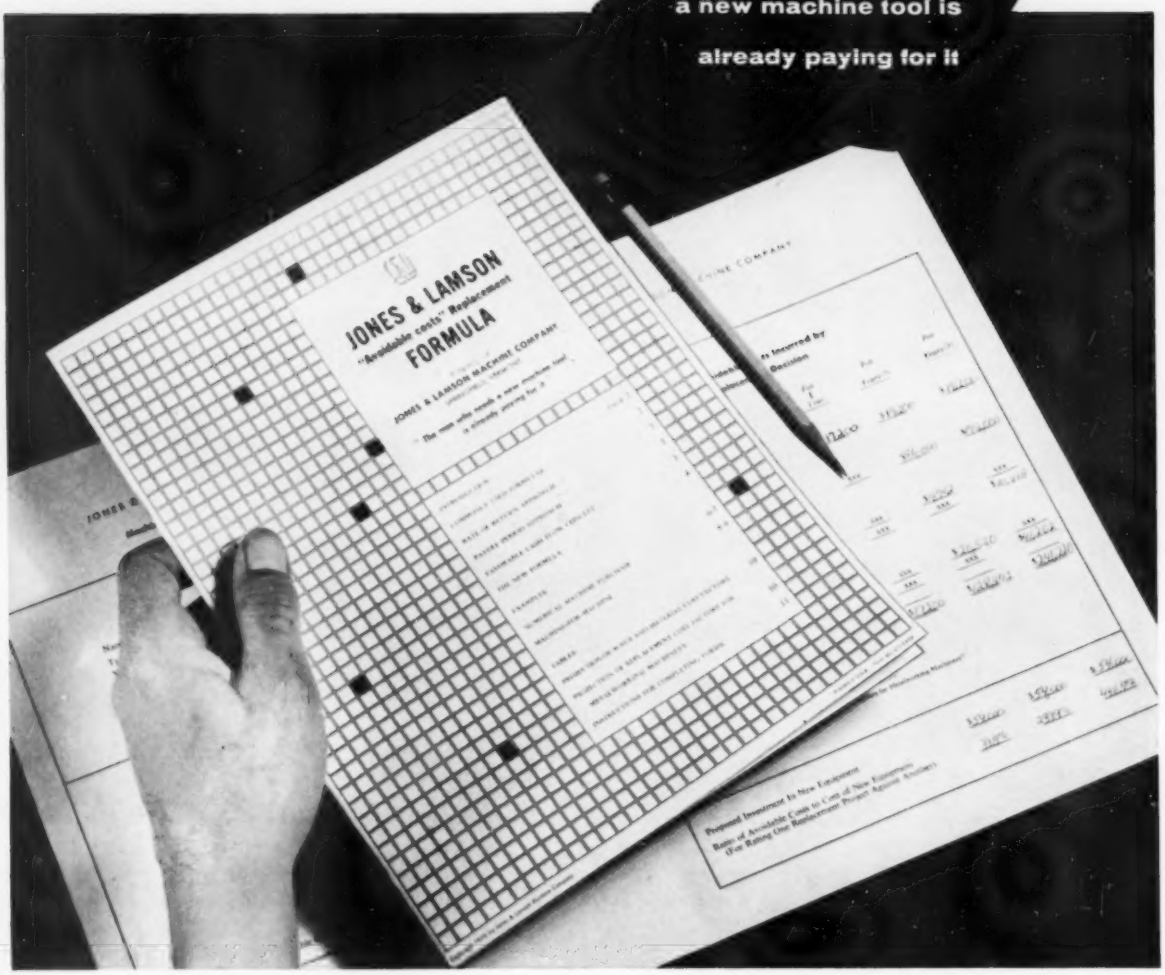
JONES & LAMSON MACHINE COMPANY

the man who needs a new machine tool is already paying for it



How to get Equipment Dollars from Management

To management men, nothing speaks so eloquently as facts. Take the men in *your* front office, for instance. When told that a new machine tool (or several new ones) is a "must", they may very well be inclined to agree. But they have to be *shown*.

In order to sell management, you must present an accurate, factual statement, comparing current productivity of existing equipment, with the productivity attainable with new, advanced equipment.

And this is where you must exercise extreme caution.

Why?

Because, practically without exception, the formulas commonly used for evaluating machine tool performance contain flaws, fallacies and limitations which are seriously misleading. They give an erroneous picture because they distort the facts.

Happily, J & L has the answer to this problem. It's the new J & L "Avoidable Costs" Replacement Formula, which gives you an easy, step-by-step method of productivity evaluation which is logical, accurate and reliable. This formula is tried and true. It gives you a clear, true picture and supplies you with the facts you need in order to get that new machine you're looking for.

For your copy of J & L's "Avoidable Costs" Replacement Formula, together with easy-to-use work sheets, write Jones & Lamson Machine Company, 518 Clinton Street, Springfield, Vermont.

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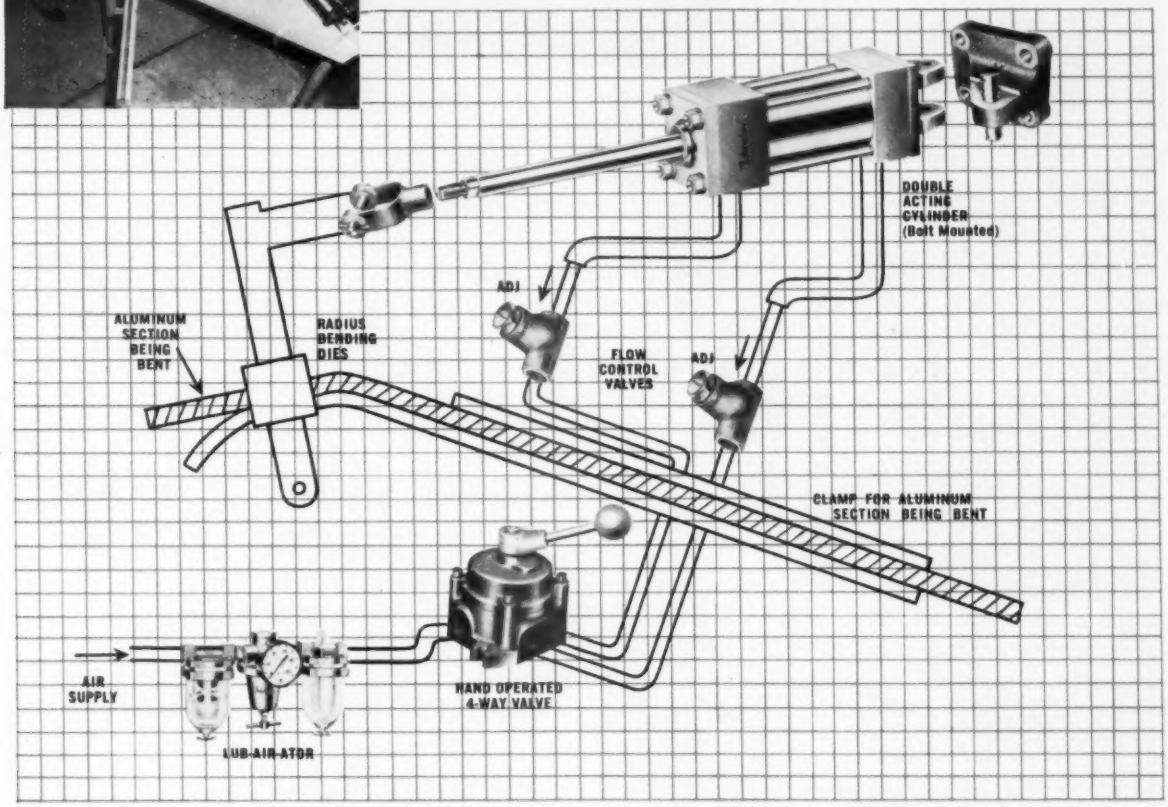
A typical example of how fabricators use Schrader. Schrader Air Products in the schematic perform a metal-forming operation at Lance Awning Corporation, Lake Worth, Florida. Power is supplied by a Schrader double-acting bolt-mounted air cylinder. By pressing the Schrader 4-way valve, the cylinder piston advances at proper speed, checked by Schrader flow control valves, bending an aluminum section to the desired angle. Reversal of the 4-way valve returns the cylinder and bending dies to rest, permitting removal of the bend section. "Air control provides a straightforward one-man job," says the Plant Manager. "Two men worked hard to form this radius bend on 25 parts per hour before a Schrader Air Cylinder was installed. Now one man forms 35."



FABRICATOR JUMPS PRODUCTION 40%... CUTS COSTS IN HALF WITH STANDARD SCHRADER AIR PRODUCTS

Get higher production at lower cost, just like this company . . . with the *air* you already have! You can't beat Schrader Air Products for accuracy, economy, speed —and lasting quality.

Air can save manhours . . . slash operating costs . . . upgrade practically any operation such as inspecting, assembling, testing and packaging. It can push, pull, hold, position and move work repetitively . . . make light of weight-lifting . . . accelerate production . . . unplug bottlenecks . . . all at unmatched low cost and drop-in-the-bucket maintenance.

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Select your automating equipment from the full Schrader line. Your Schrader distributor can help you pinpoint what you need. For more data write:

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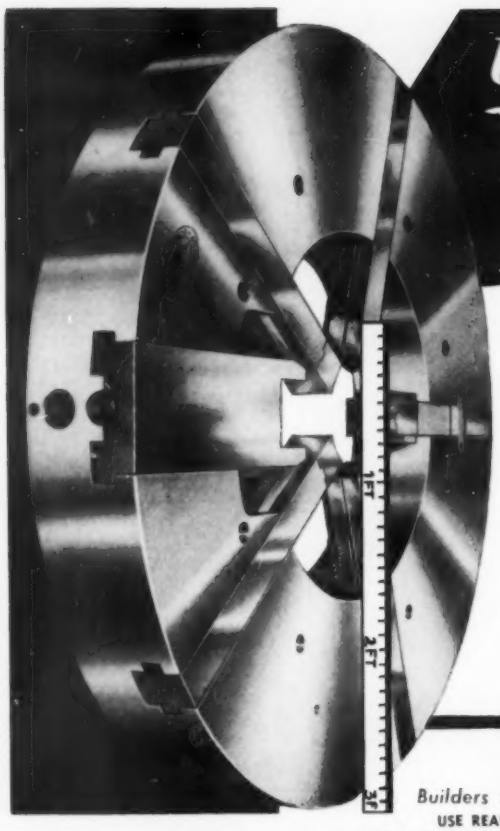
462 Vanderbilt Avenue, Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS



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from very large (60" in diameter as illustrated)
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Recent Developments in the Theory and Application of Electrical Discharge Machining	220
Precision Roll Grinding with Coated Abrasive Belts	221
Hand Straightening of Small Parts: Method Improvement and New Tooling	222
Techniques for Machining & Welding 6061 (61S) Soft Aluminum Forgings	223
Machining of Zircoloy	224
How Positional Tolerancing Clarifies Design Intent and Reduces Product Cost	225
Rigged For Economy and Producibility	226
Practical Applications for Plastic Tools in the Aircraft and Missile Industry	227
Draw Die Abrasion Resistance Test	228
Recent Developments in Explosive Forming at Grumman Aircraft	229
Optimum Tolerances of Sheet Materials for Flight Vehicles	230
Parts Inspection and Decision Making by Electronics	231
Special Electronic Test Equipment and its Relationship to Mechanical Tooling	232
Production Through Safeguarding	233
Safety and Production—Die Design	234
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Collected Papers, Department 10
American Society of Tool Engineers
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FULL PAYMENT OR COMPANY PURCHASE ORDER MUST ACCOMPANY ALL ORDERS

THEY SPEND MORE pennies

TO MAKE MORE dollars

Without coolant, this Bullard lathe makes a .125 rough cut and .050 finish cut using Kennametal Grade K6 inserts in a Kendex* (patented) holder. Sand holes in the castings add to the difficulty of an interrupted cut. Photos and production data courtesy of American Coleman Company, Littleton, Colorado, manufacturers of trucks, tractors, front drive axles, and related parts.

	50 RPM 24 Minute Tool Life	88 RPM 15½ Minute Tool Life
Feed	.027	.027
Cutting Time:		
First side—rough cut	7 minutes	4½ minutes
First side—finish cut	7 minutes	4½ minutes
Second side—rough cut	5 minutes	3¼ minutes
Second side—finish cut	5 minutes	3¼ minutes
Total cutting time	24 minutes	15½ minutes
Machine cost per hour	$6.00	$6.00
Tool cost per hour	.075	.27
Machine and Tool cost/8 hours	$48.60	$50.16
Pieces finished per 8 hours	5	9
Cost per piece	$9.72	$5.57

KENNAMETAL* tooling permits 75% SFM increase... cuts cost per piece almost in half

Like many others, this plant is sacrificing pennies in tool costs to make dollars in production profits. At 50 rpm, this boring mill faced cast iron housings at a maximum speed of 289 sfm. Each Kennametal cutting edge faced both sides of two pieces with production averaging 5 pieces per 8-hour shift. When the maximum speed was increased to 510 sfm, the cutting insert had to be changed for each piece.

This reduction in machining time, plus some additional time saved by an improved method of holding the workpiece, enabled production to increase to 9 pieces per shift.

Sacrificing a few pennies of increased tool costs to make dollars in production profits is not a new idea. It has been proven-in-use by many progressive plants, and we will gladly send you records of such operations. These results can be duplicated in other plants where machines and talented operators have been held back by old ideas about tooling and tooling costs.

Ask your Kennametal Carbide Engineer how Kendex* (patented) tooling can help you get more efficient output from *your* machines . . . or write direct for the booklet, "There's Profit in Retiring a Tradition." KENNAMETAL INC., Latrobe, Pennsylvania. 97237

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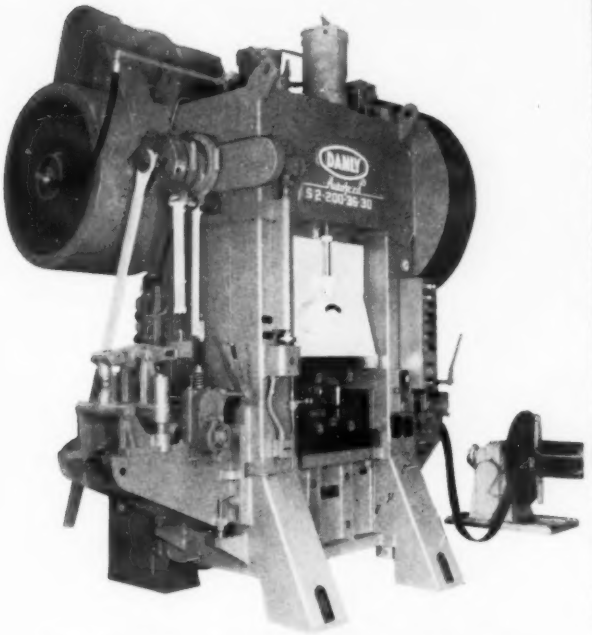
The Leading Supplier to the Stamping Industry

in PRESSES

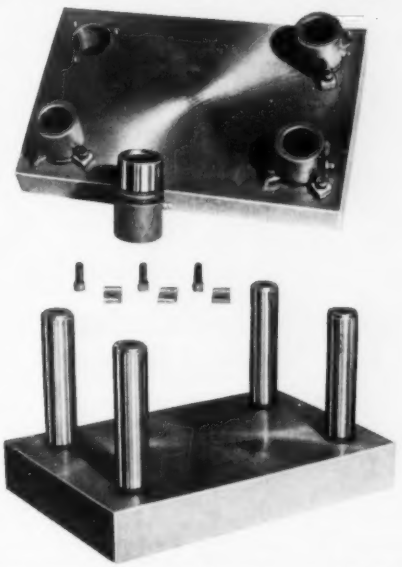


Look at the Nation's most modern stamping plants . . . see which press you find most frequently . . . you'll discover it's Danly! There are good reasons for this. You get lower operating costs with Danly Presses—you can depend upon it! The extra muscle and precision built into all Danly equipment means smoother die closure, less vibration, less die wear. Danly Presses reduce profit-eating maintenance and spare parts inventories . . . produce more accurate stampings, and more parts per shift.

There are many new developments you should know about, such as the Quick Die Change feature available on all Straight Side Presses . . . single, double and triple action . . . the modern high-production Autofeeds . . . and the completely modern line of Open Back Inclinable presses just introduced. See how Danly can help you reduce costs and give your products the stamp of leadership!

Write for the new Autofeed Catalog that gives full information on Danly Presses for high-production stampings.

in DIE SETS and Die Makers' Supplies



With the introduction of the Demountable Bushing Die Set, Danly is now working on its fifth million in die set production. Included in this production are die sets mounted in five Danly Autofeed Presses that produced a million pieces per grind with an average of 219,000 pieces per .001 inch of die grind.

In every instance, Danly can meet your most exacting diemaking specifications with a die set—standard or special. Since pioneering the first mass-produced precision die sets 36 years ago, Danly has continuously developed new production, inspection and distribution methods to serve you better.

Today, there's the new Danly Die Set with Demountable Bushings being assembled in a factory branch or distributor assembly plant near you. It is your fast, convenient source for toolroom and pressroom supplies that bear the stamp of leadership. Danly facilities for special Die Set manufacture are also improved and expanded .

Send for money-saving facts. Write us and your distributor or branch will give you helpful information on Danly Die Sets.

DANLY MACHINE SPECIALTIES, INC. 2100 S. Laramie Avenue, Chicago 50, Illinois

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DANLY®

A NEW AMERICAN STANDARD *FOR DIAMOND DRESSING TOOLS*

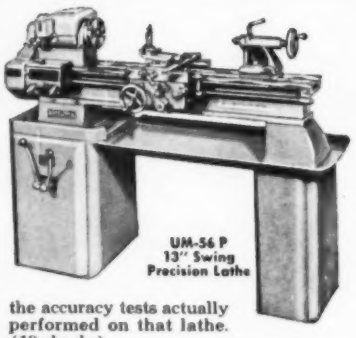
A new American standard covering classification, designation, definition, and shank dimension tolerances of diamond tools used for dressing or truing grinding wheels has been developed by the American Society of Tool Engineers.

Officially known as *Diamond Dressing Tools, B67.1-1958*, the new standard is the result of a six-year cooperative effort by ASTE and the Industrial Diamond Association of America. Nomenclature has been approved by the American Standards Association. Copies distributed to foreign standards bodies have received world-wide acceptance.

DIAMOND DRESSING TOOLS is available at $1.00 per copy. Please address orders and remittance to Standards Dept. SP-11, AMERICAN SOCIETY OF TOOL ENGINEERS, 10700 Puritan Avenue, Detroit 38, Michigan.

SHELDON Precision LATHES

for the size Lathes You Need Most



UM-56 P
13" Swing
Precision Lathe

Sheldon lathes are built in the sizes you need most, for toolroom and production jobs. They are available with swings of 10", 11" and 13"... in varying bed lengths with 18" to 48" center distances . . . and . . . in your choice of pedestal, cabinet or bench mountings.

Powerful, all-V-belt, drive units—either the standard 8-speed (or 16-speed) E-drive; or the production favorite, a rapid, lever-shift U-drive. Where higher spindle speeds are desired, the standard E-drive can be built to provide speeds up to 2,000 r.p.m.

All Sheldon Lathes have handscraped, built-in precision. Each lathe is guaranteed to meet or surpass the American Standards for Toolroom Accuracy. With every Sheldon Lathe goes a copy of the accuracy tests actually performed on that lathe. (19 checks).

Important optional features include: hardened bed ways, L00 Long Taper Key Drive spindles, 4" D1 Camlock spindles, bed turrets, taper attachments and a complete line of toolroom and production accessories.

The new Sheldon-built Sebastian Geared Head Lathes have greatly increased work capacity and many advanced features. These include a wide, heavy, hardened and ground bed . . . easy shifting spindle speed dial . . . 60-pitch gear box . . . independent drop lever apron clutches . . . cam-action tailstock clamp . . . and, automatic lubrication in the headstock and apron with "1-shot" lubrication of carriage.

Sheldon-Built
Sebastian 13" and 15" Geared Head
Precision Lathes

SHELDON
Horizontal Milling Machine

SHELDON
12" Shaper

SHELDON MACHINE CO., Inc.

Builders of Sheldon Lathes, Milling Machines, Shapers and Sebastian Lathes.

4229 North Knox Ave • Chicago 41, Ill.

Send in coupon or write for catalogs and names of nearest Sheldon and Sebastian Distributors where you can see these new lathes in operation.

SHELDON MACHINE CO., INC.
4229 North Knox Avenue, Chicago 41, Illinois

Gentlemen: Please send new catalogs describing:

☐ Sheldon ☐ 10", ☐ 11' ☐ 13" Lathes
☐ Sebastian 13" and 15' Geared Head Lathes
☐ Horizontal Milling Machine ☐ Name of Local Dealer
☐ Sheldon 12" Shaper ☐ Have representative Call.

Name ..... Title .....

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Street Address ..... ☐ Company ☐ Home

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ASK A MAN

—*"What Would You Like in a Die Handbook?"* Chances are good he'll tell you that he needs a collection of hundreds of practical designs out of the current practice of many leading die designers and users. He'd like such information as he would hope to get for himself, if he were free to personally visit the sources.

WE ASKED MANY MEN

—Checked ASTE members—surveyed hundreds of industry men—found that die designers and users want to know from the start *how someone else successfully solved a particular die problem*—how to avoid repeating the difficulty and delay of costly die design development.

WE *PENETRATED* INDUSTRY

—took full advantage of ASTE's unique resources to give you the best practice of "in industry" specialists for the *first* time . . . gathered together the intimate working data of many companies in the field—made it publicly available.

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—of the *"Die Design Handbook"* since its publication . . . How much is it worth to you?

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DIE DESIGN HANDBOOK

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Please send the DIE DESIGN HANDBOOK to the address below:

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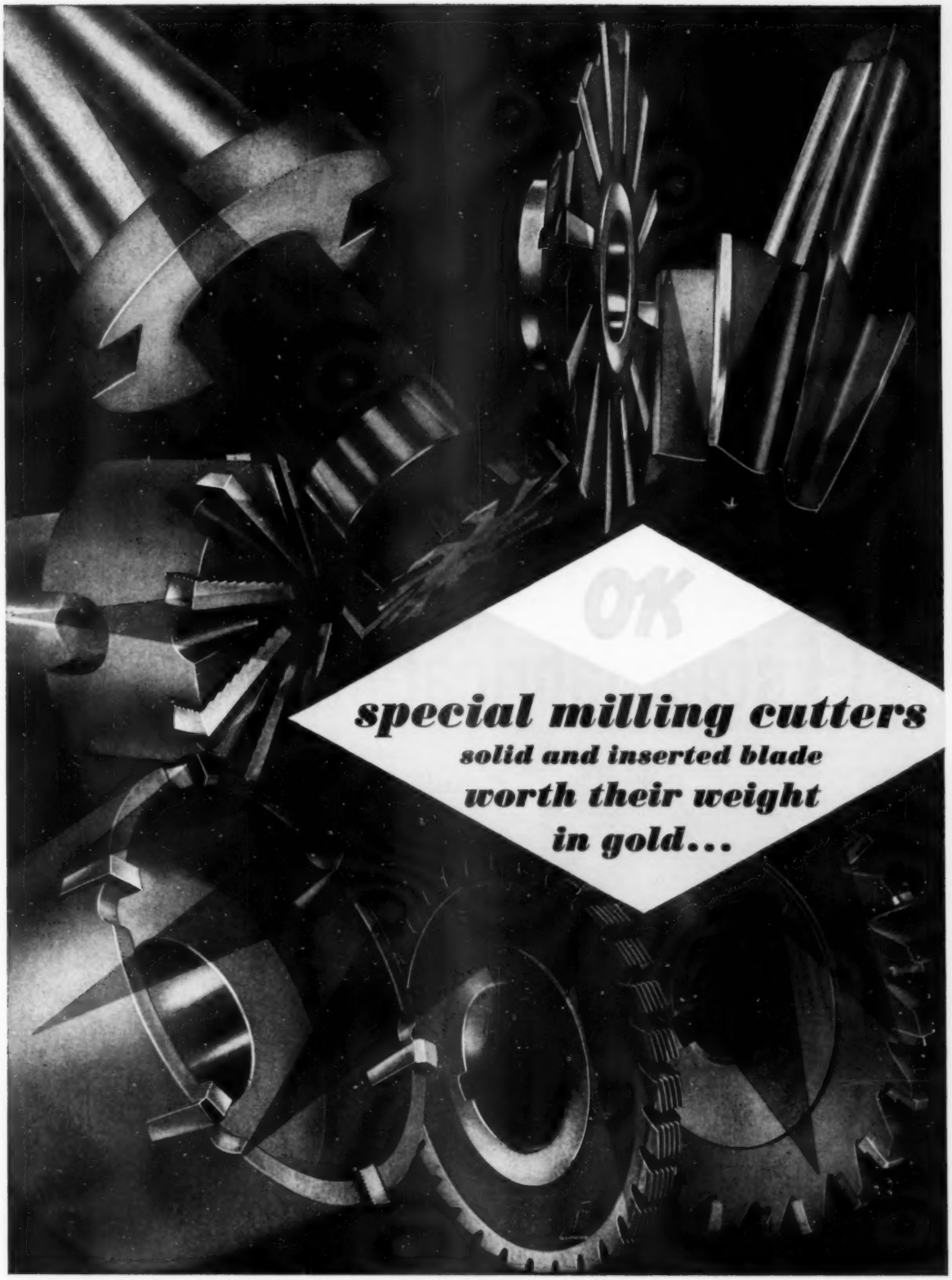
Remittance payable to the Society must accompany order. Do not send currency. Mail this order coupon to: AMERICAN SOCIETY OF TOOL ENGINEERS, Dept. SP-2A, 10700 Puritan Ave., Detroit 38, Mich.



Counter-clockwise: An O K special solid HSS profiling cutter with taper shank. Special inserted blade angular mill. Special inserted blade keyseat cutter with taper arbor. Special inserted blade end mill with taper shank. Special inserted blade trepanning head. Special solid HSS form relieved serrating tool. Special solid carbide tipped staggered tooth cutter. Put your milling problems up to O K engineers. THE O K TOOL COMPANY, INC., Milford, N. H.

New, high-tensile steels require special care when welding.

Submerged arc welding gives the most reliable performance with T-1,
but . . .
most conventional, submerged arc equipment is impractical for one-of-a-kind jobs . . . like a 28 cubic yard bucket.

That's why Peabody Coal Company used a "Mechanized Squirt Welder".
The "Mechanized Squirt" gives the user all the control and high quality of completely automatic submerged arc welding without the need of expensive fixtures.

Mechanized "Squirt" simplifies T-1 steel fabrication...

RESULT: Peabody Coal welded the T-1, firebox-grade steel at speeds up to four-times faster than manually, with the "Mechanized Squirt Welder" and got perfect welds with L-61 electrode and Lincoln alloy flux.

For complete details on the "Mechanized Squirt Welder" write to us for Bulletin 5205.1.

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world's leading manufacturer of arc welders and electrodes, ac motors and battery chargers

DIEMAKERS...

Cut costs here

Free-machining DESEGATIZED® HIGH ALLOY DIE STEELS

4

grades regularly stocked for long-run die applications...

- OLYMPIC FM (Type D-2)
  ... for typical long-run applications
- BR-4 FM (Type D-7)
  ... for extreme abrasive service
- GSN FM (Type D-3)
  ... to meet non-deforming requirements
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  ... for extra resistance to galling and pickup

Latrobe's 12% chromium die steels are easier to work, easier to machine . . . because they contain evenly-dispersed, fine alloy sulphides which permit faster speeds and feeds, and result in better machined surfaces.

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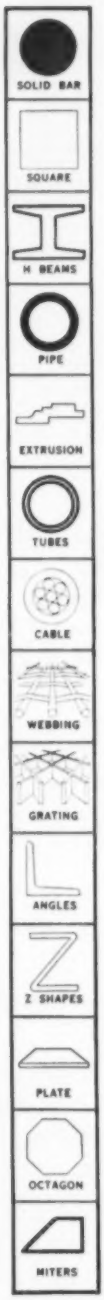
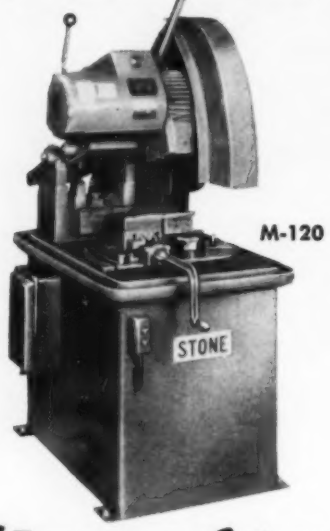
High-Speed Cutting
of ferrous and non-ferrous metals...
and non-metallic materials...





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Used by every major industry throughout the world, Stone machines are famous for *fast, accurate* cutting . . . delivering smooth, mill-like finishes to extremely close tolerances . . . at cutting rates of less than 4 seconds per square inch. The high popularity of Stone cutting machines is supported by such practical features as the following:

- Geared-in-head motor (a Stone exclusive)
- Precision designed head and frame
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- Choice of 3½ to 15 HP motors

Stone's Complete Line of Chop-Stroke, Miter and Traverse-Type Machines is fully described in new literature containing latest developments and improvements. SEND FOR IT TODAY!

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HIGH SPEED CUTTING MACHINERY

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There's No "GUESS WORK" with a TINIUS OLSEN AIR-O-BRINELL Metal Hardness Tester

Preset the exact load you want by means of accurately regulated and maintained air pressure—no dead weights or hydraulics. Reproducible load application is assured. Use anywhere standard air pressure is available—in lab or shop.

Get the facts. Write for Bulletin 52.

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NOW-
Carr-Lane has opened the gateway to
STAINLESS STEEL COMPONENTS

Non-Magnetic, Non-Corrosive Jig and fixture components. Use them for weld fixtures to save time and money on these difficult parts. All are the usual Carr-Lane quality and precision made.

Investigate Now!

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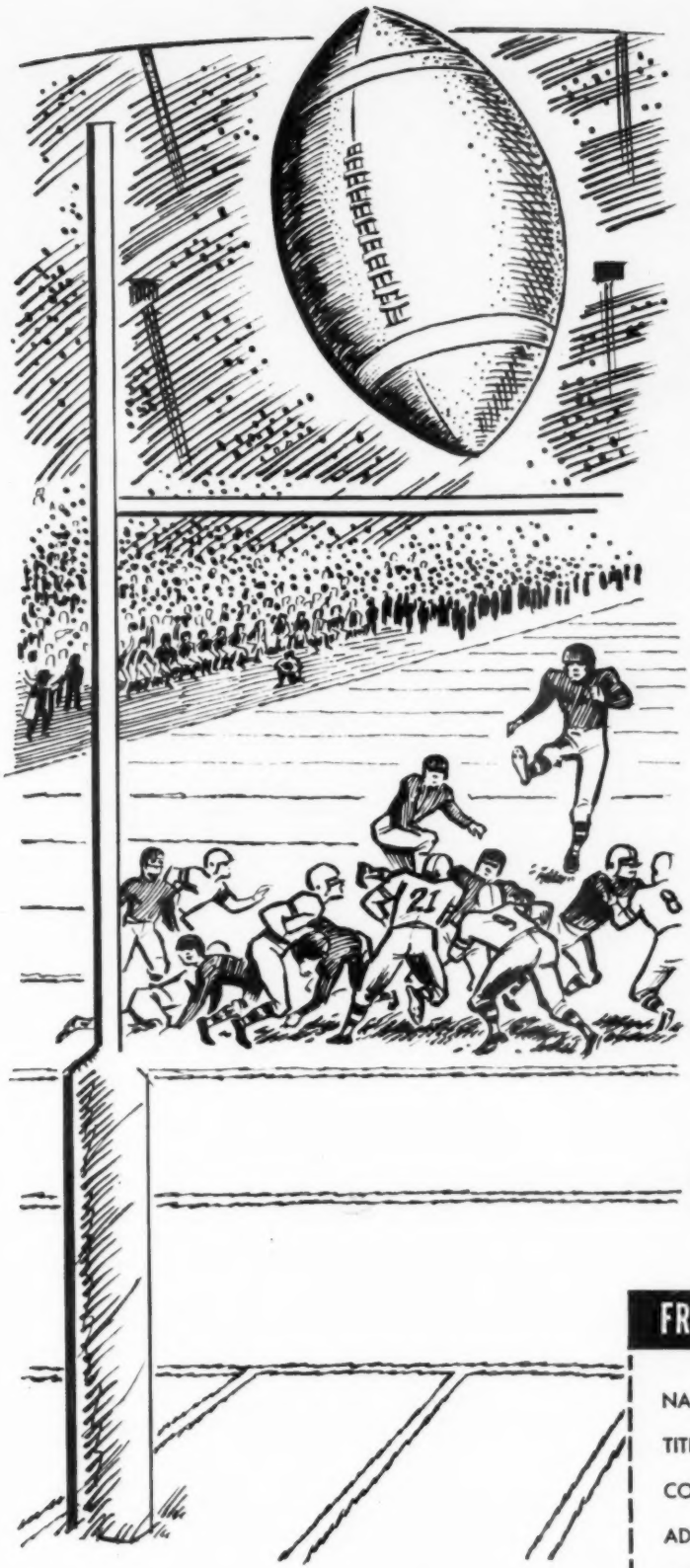

When ACCURACY Counts...

Acme Industrial Company for over 40 years scored unerringly with precision, capacity, and its "person to person" customer relationships.

Just as in any sport the ingredients for success are versatility, capacity, accuracy and ingenuity, Acme has proven time and again to have the right ingredients.

Acme's modern plant contains over 300 metal working machines and 200 pieces of laboratory testing and inspection equipment for maintaining tolerances from .001 to .00001 inch.
Being specialists in hydraulic actuating cylinders and pistons, Acme's contract, research and development work are designed to meet the Industrial Security Board's requirements.

Acme can produce any part, one or a million, any finish, hardened and ground, or assemblies in ferrous or non-ferrous materials to order from your specifications.

Why accept second best, only Acme Industrial is first in the field of custom precision manufacturing.

Send your blue prints and specifications for quotation.

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FREE! Write for our new facility booklet now

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the NEW *Roto-Finish* VIBRATRON®...

THE COMPLEX FINISHING JOBS IT DOES...
THE *REAL* MONEY IT SAVES!

VIBRATRON...

the profitable way to precision, mass production finishing

ROTO FINISH

In the Vibratron, complex parts with shielded and hard-to-reach internal surfaces can be precision finished *mechanically* ending costly hand operations. *All* surfaces of the part are exposed to abrasive action *all* of the time. Time cycles are cut 300%, 500%, even more; so media and compound costs go down too!

Equally important, the Vibratron puts an end to manual handling of parts and media. A built-in, removable, double-decked vibrating separator separates parts and media, as well as fragments from the media in one simple operation. There's no need for an extra separator.

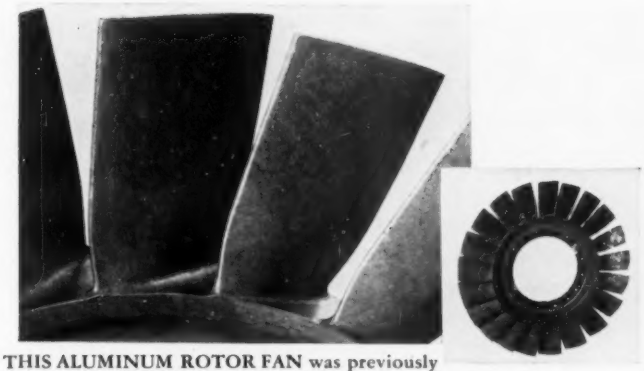
The Vibratron is simple in design. Uses standard, *tested* components which require minimum maintenance. Power requirements are low. Fixturing is easy because of the open tank design. Another advantage . . . noise level is at a low hum. The machine need not be bolted down.

Roto-Finish / RANSOHOFF

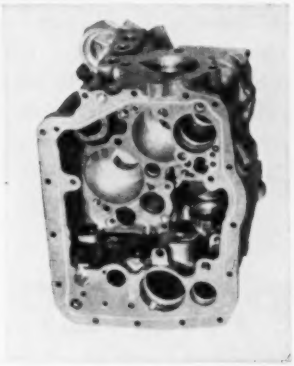
FOREIGN REPRESENTATIVES: ARGENTINA—Tatler—Buenos Aires ● AUSTRALIA—A. Flavell Ltd. Cheltenham ● BRAZIL—Commercial E. Industrial de Fornos Werco, Ltd.—Rio de Janeiro ● CANADA—Canadian Hanson & Van Winkle Co., Ltd.—Toronto ● ENGLAND—Roto-Finish Ltd.—Hemel Hempstead ● FRANCE—Societe Roto-Finish—Paris ● GERMANY, AUSTRIA, NORWAY, SWEDEN, SWITZERLAND—Metallgesellschaft A. G.—Frankfurt, a. M.—Germany ● HOLLAND, BELGIUM, LUXEMBURG—N. V. Roto Finish Maatschappij—Delft, Holland ● ITALY—Societa Roto-Finish a R. L.—Milan ● MEXICO—Enthone de Mexico, S.A. Prol Pina 669, Mexico 15, D. F. ● SPAIN—Instituto Electroquimico, S. A.—Barcelona

NOW THERE'S NO NEED FOR HAND FINISHING OPERATIONS ON PARTS LIKE THESE . . .

The above diagram shows how the Vibratron work zone extends throughout the abrasive mass. Every part is subject to a constant abrasive action.



THIS ALUMINUM ROTOR FAN was previously deburred, and *still* surface irregularities were not removed. IN THE VIBRATRON they are fixtured 10 parts per machine. Time cycle: one hour. No hand work required. Surface greatly improved.



Before Vibratron processing this aluminum sand casting (shown above) was hand deburred, then tumbled into a multiple compartment machine for 30 minutes. IN THE VIBRATRON it is processed 4 parts to a machine. Time cycle: 15 minutes. No hand operations required. Finish is far more uniform.

It took two belting operations *and* 20 hours of tumbling to blend in grinding lines on these forged shears, still parts were sometimes distorted during processing. THE VIBRATRON time cycle is 6 hours. No hand work required. No part distortion.

This complex business machine part previously required hand deburring because barrel finishing bent the parts. IN THE VIBRATRON 100 parts are completely deburred in a 30 minute cycle.

With the Vibratron . . . you can clean, descale, deburr, form radii, fine-finish and color stamped, cast, forged and machine parts, finish them faster . . . better . . . and more economically.

LET US PROVE IT TO YOU

Send a few unfinished parts to us . . . and a finished part to use as a guide. *We will process them for you and guarantee the same results in your plant as we get in our finishing laboratory.*

Roto-Finish COMPANY
3745 Milham Road, Kalamazoo, Michigan

Call on Roto-Finish / **RANSOHOFF for complete "finishing-engineering" service**

☐ My parts are on the way to you.

☐ Please have Roto-Finish factory representative call for an analysis of my finishing problem.

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there's nothing new in Socket Set Screws!

The revolutionary P-K W-POINT Socket Set Screw is not only new—completely new—it is capable of delivering the highest degree of holding power ever attained... at no increase in price!

What's the difference between the new P-K W-Point and ordinary cup point set screws? It's the new pivot point that's built into the cup! This exclusive P-K feature reduces "wobble" caused by the required tolerance clearances between screw threads and the tapped hole . . . minimizes "tipping" motion imparted by key tightening . . . creates tracking which is uniformly even in depth and shape . . . results in frictional engagement of both cup edge flanks . . . provides:

30% more back-out torque

50% more resistance to vibration

50% more resistance to rotary slippage

Test this new socket set screw in your own plant. Ask your P-K Industrial Distributor for complete information and samples today, or write to P-K direct for technical bulletin No. 1106.

PARKER-KALON® W-POINT Socket Set Screw

PATENT PENDING

PARKER-KALON, *a division of General American Transportation Corporation. Clifton, New Jersey. Offices and Warehouses in Chicago, Los Angeles.*

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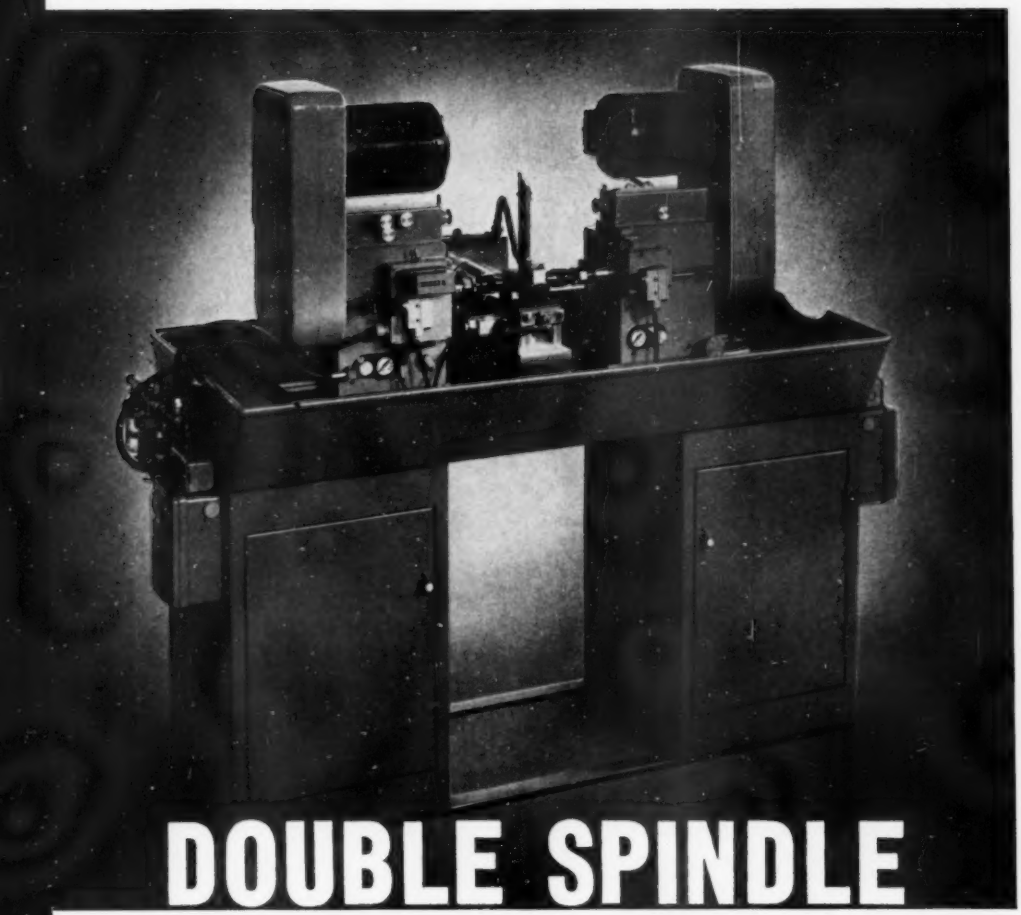
City Zone State

UNIVERSAL-AUTOMATIC CORPORATION



DOUBLE SPINDLE

MAGAZINE FEED HOPPER FEED

HORIZONTAL DRILLING MACHINES

HIGH SPEED PRODUCTION METHODS
CROSS-DRILLING
TAPPING
END FORMING
FACING
THREADING
NUT TAPPING
DEBURRING
RIVET DRILLING & TAPPING
COUNTERSINKING
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CAPACITY—3/8 STEEL

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Thor discovers how to muffle air motor noise

75% quieter!

NEW THOR SILENTAIR SCREWDRIVERS

Less noise on your lines means more production, better employee relations and morale

YES, here is 75% less noise on your production line . . . the great new Thor "Silentair" Screwdrivers! A steel sleeve with 24 perforations is attached over the exhaust of any of these Thor No. 2 series straight screwdrivers. This sleeve, with its acoustical pattern of holes, breaks up and absorbs the sound of the air motor.

Hear the difference between standard air driven screwdrivers and Thor's new "Silentair." Try one. Then try the other. Then you'll know what silent air power can mean in your plant.

"Silentair" is optional equipment on Thor air screwdrivers—the most powerful available to industry. For a demonstration, contact your nearest Thor factory branch listed below, or write Thor Power Tool Company, Aurora, Illinois.

Quiet power on your lines lets employees do better work, improves output—fewer mishaps, mistakes.

Thor PORTABLE POWER TOOLS

THOR POWER TOOL COMPANY
AURORA, ILLINOIS

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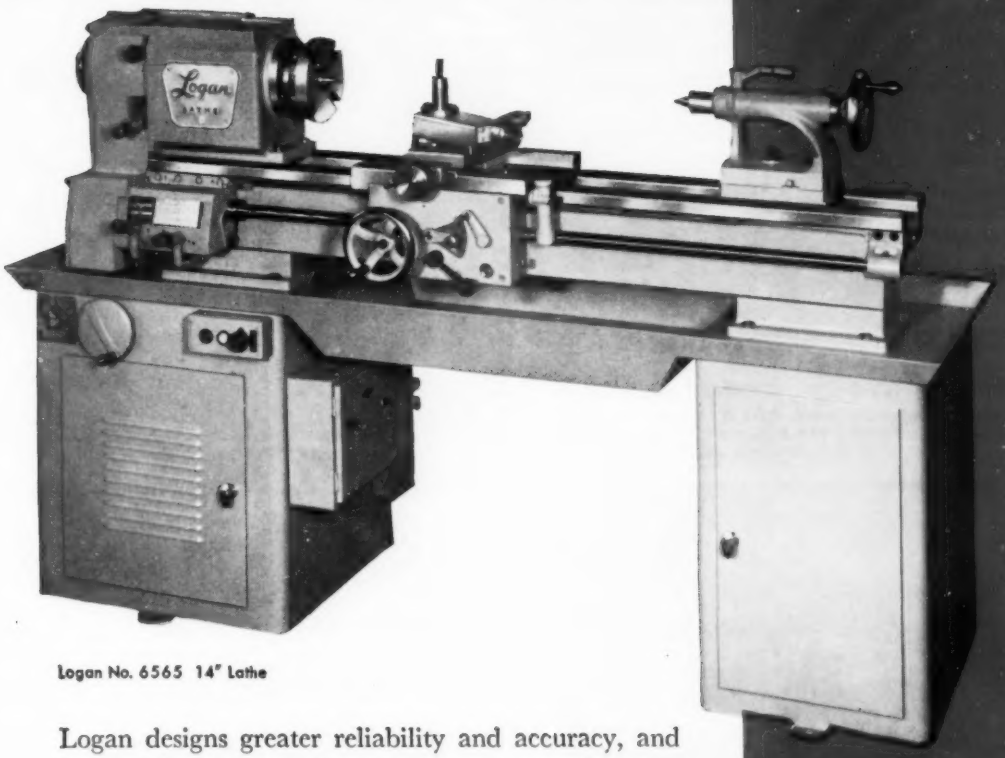
its specifications add up to high production capacity

Logan 14" Lathe



Logan No. 6565 14" Lathe

Logan designs greater reliability and accuracy, and longer life into its lathes by a generous combination of high-quality features. For instance—

- An oversize spindle with 1⅝" bore turns on four super-precision ball bearings with built-in preload
- A variable-speed drive lets you change speed while work is turning—without shifting belts
- A warp-free lathe bed with high, strong walls braced by oversize ribs to withstand heaviest stresses; two V-ways and two flat ways are flame-hardened and precision-ground.

There are many more reasons why this and other Logan Lathes have a greater capacity. The specifications tell the story. Write for literature and complete information.

- Spindle speeds to 2000 rpm.
- 1½" Levermatic collet chuck capacity
- 14⅝" swing over bed
- 9" swing over saddle cross slide
- 40" between centers

LOGAN ENGINEERING CO. Dept. U-1059 4901 Lawrence Ave., Chicago 30, Ill.

New 40-TON DOUBLE CRANK O.B.I. ROUSSELLE

WITH NEW ELECTRICALLY CONTROLLED AIR CLUTCH

- "Plug-in" foot and hand controls.
- Single stroke, continuous and jog selector.
- Low air consumption.
- Large die area.
- Roller bearing flywheel.
- Bronze main and crank bearings.

No. 4B
ROUSSELLE PRESS

CHOICE OF 30 SIZES AND TYPES IN 5 TO 40-TON PRESSES

SERVICE MACHINE CO.

Mfrs. of Rousselle Presses

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ROUSSELLE PRESSES ARE SOLD EXCLUSIVELY THROUGH LEADING MACHINERY DEALERS

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SOUTHWEST
"Monoball"®
SELF-ALIGNING BEARINGS

CHARACTERISTICS

	ANALYSIS	RECOMMENDED USE
1	Stainless Steel Ball and Race	For types operating under high temperature (800-1200 degrees F.).
2	Chrome Alloy Steel Ball and Race	For types operating under high radial ultimate loads (3000-893,000 lbs.).
3	Bronze Race and Chrome Steel Ball	For types operating under normal loads with minimum friction requirements.

Thousands in use. Backed by years of service life. Wide variety of Plain Types in bore sizes 3/16" to 6" Dia. Rod end types in similar size range with externally or internally threaded shanks. Our Engineers welcome an opportunity of studying individual requirements and prescribing a type or types which will serve under your demanding conditions. Southwest can design special types to fit individual specifications. As a result of thorough study of different operating conditions, various steel alloys have been used to meet specific needs. Write for Engineering Manual No. 551. Address Dept. TE

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COLUMBIA TOOL STEELS

For over fifty years COLUMBIA has built its reputation on tool steel that is good for you

Product of Skilled American Workmen

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ONE DAY DELIVERY

YOUR DIES AND STAMPINGS

SEND PRINTS

PATENT PENDING

"PAY-LES METHOD"

Payne Tool and Engineering Co.

SPRINGFIELD, OHIO

REPRESENTATIVE WANTED

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1959-60 NEW SEMINARS FOR CREATIVE MANUFACTURING

What About Your Future?

WHAT DOES THE FUTURE HOLD FOR YOU? WITH EACH TICK OF THE CLOCK THE WORLD CHANGES. DREAMS BECOME REALITY—NEW METHODS—NEW TECHNICAL PROGRESS—NEW DEMANDS FOR TOOL ENGINEERING. *LET US LOOK INTO THE FUTURE TOGETHER.*

SEMINAR TOPICS

***Metal Forming**—new materials - impact process - explosives - high energy rates - stamping - forging - ingot improvement - power spinning - roll forming - producibility and material utilization.

***Metal Cutting**—latest improvements machining methods - integrate recent data and applications - single point turning - milling - drilling - broaching.

***Space Age Metals**—problem solving methods - new materials - superalloys - machining - electric discharge - electro-mechanical - chem-milling - electrolytic grinding and vacuum melted castings - powder metallurgy.

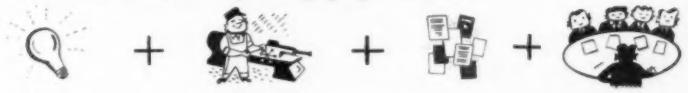
***Numerical Control**—potential complete systems and evaluation - trends - methods - future developments and data - accuracy - tool life - surface finish.

***Optical Tooling**—cost-saving optics for industry - alignment - quality control - production set-ups (Los Angeles only work-shop study - set-up methods - tooling problems)

***Automation**—how to automate - cost-saving production - data-methods of practical applications - types and systems.

***Plastic Tooling**—manufacturing developments in plastics - fabrication-tooling techniques, physical properties-design fundamentals - workshop study.

***Dimensional Metrology**—new international inch - tightness of tolerances and discussions - affect on air electronic - mechanical - optical gaging methods.



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WHAT WE KNOW TODAY ABOUT METAL CUTTING	1M25 1M32	Jan. 28-29, '60 May 12-13, '60	San Francisco Chicago	Sheraton-Palace LaSalle
SOME PROBLEMS OF MACHINING SPACE AGE METALS	1M21 1M30	Nov. 17-18, '59 Mar. 8-9, '60	Philadelphia San Francisco	Sheraton Sheraton-Palace
NUMERICAL CONTROL IN CREATIVE MANUFACTURING	1M24 1M22	Jan. 26, '60 Dec. 10, '59	Los Angeles Hartford	Ambassador Bond
OPTICAL TOOLING METHODS IN MANUFACTURING	1M23 1M28	Jan. 12, '60 Mar. 1-2, '60	Philadelphia Los Angeles	Sheraton Ambassador
AUTOMATION AND YOUR PRODUCTION PROGRAM COST REDUCTION THROUGH PLASTIC TOOLING	1M26 1M27	Feb. 4, '60 Feb. 24-25-26, '60	Detroit St. Louis	Sheraton-Cadillac Chase-Park Plaza
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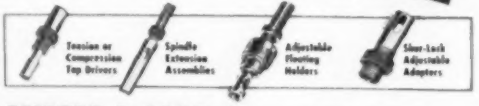

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Index of Advertisers

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The Index to Advertisers is published as a reader service. Although every precaution is taken to assure correct listing, no allowance will be made for error or omission.

*Exhibitor in 1958 ASTE Industrial Expositions
♦Suppliers Directory Issue Advertiser

A

♦*Accurate Bushing Co. 157
*Ace Drill Bushing Co. 206
*Ace Drill Corp. 201
Acme Industrial Co. 257
Aero-Test Equipment Co., Inc., Perfecto-Peen Division 199
♦*Airborne Instruments Laboratory, A Division of Cutler-Hammer Co. 166
*Alina Corp. 170
♦Allegheny Ludlum Steel Corp. 50, 218
Allen Mfg. Co. 171
Allou Engineering, Inc. 197
*American Chain & Cable Co., Inc., Wilson Mechanical Instrument Division 190
♦*American Drill Bushing Co. 17
♦*American Society of Tool Engineers 230, 265
American Tool Works Co., The 2
Armstrong-Blum Mfg. Co. 164
*Armstrong Bros. Tool Co. 181
*Austin Industrial Corp. 189
♦*Automation Devices, Inc., Perry Equipment and Engineering Division and Vibratory Feeder Co., Division 176

B

♦*Barber-Colman Co. 72-73
♦Bath & Co., John 51
Bay State Abrasive Products Co. 70-71
Bellows Co., The 186
♦*Besly-Welles Corp. 220
Bethlehem Steel Corp. 148
Black & Decker Corp., Master Power Corp., Subsidiary 188
*Blake Co., Edward 161
Blanchard Machine Co., The 12
♦*Bliss Co., E. W., Die Supply Division 152
Press Division 217
Borg-Warner Corp., Rockford Clutch Division 156
Boston Gear Works 219
Brightboy Industrial Products Division, Weldon Roberts Rubber Co. 235
*Bristol Co., The 214
♦*Brown & Sharpe Mfg. Co. Nelco Cutting Tools Division 193
*Bruning Co., Charles 223
Brush Instruments Division, Clevite Corp. 212
♦*Buck Tool Co. 154
♦Bullard Co., The 231
Butterfield Division, Union Twist Drill Co. 194

C

Card Division, S, W., Union Twist Drill Co. 48
♦*Carr-Lane Mfg. Co. 256
*Challenge Machinery Co. 162
*Chicago Pneumatic Tool Co. 69
Cincinnati Milling Machine Co. 21
Cincinnati Milling Machine Co., Heald Machine Co., Subsidiary ..... Inside Front Cover
♦*Circular Tool Co. 179
♦Clearing Machine Corp., Division U. S. Industries, Inc. ..... Back Cover
Cleveland Tool & Die Co., The 200
Cleveland Twist Drill Co. 225
Clevite Corp., Brush Instruments Division 212
♦*Cogsdill Twist Drill, Inc. 4
Columbia Tool Steel Co. 264
Cosa Corp. 226
Crane Packing Co. 43
Cross Co., The 14-15
♦*Cushman Chuck Co. 45
♦*Cutler-Hammer Co., Airborne Instruments Laboratory, Division 166
*Cutter Division, The Ingersoll Milling Machine Co. 238

D

*Danly Machine Specialties, Inc. 251
Dayton Rogers Mfg. Co. 214
♦*Detroit Stamping Co. 237
♦*Devcon Corp. 183
DeVlieg Machine Co., Jigmill Division 52-53
♦*DoALL Co. 240-241
*Dow Chemical Co., The 24-25
Dumore Co., The 66
Dykem Co., The 214
Dynapak Convair. Division of General Dynamics Corp. 239

E

♦*Eastman Kodak Co. 207
♦*Eclipse Counterbore Co. 267
♦*Emhart Mfg. Co. 146
Ettco Tool & Machine Co., Inc. 191
♦Ex-Cell-O Corp. ..... 63, Inside Back Cover

F

♦Futurmill, Inc. 42

G

Gaertner Scientific Corp. 183
♦Gardner-Denver Corp. 216
Gardner Machine Co. 7
♦*General American Transportation Corp., Parker-Kalon Division 260
General Dynamics Corp., Dynapak Convair, A Division 239
Stromberg-Carlson, A Division 178
*General Electric Co., Metallurgical Products Department 29-30-31-32
Silicone Products Department 37
♦Giddings & Lewis Machine Tool Co., Kaukauna Division 168-169
Gisholt Machine Co. 8
♦Gorton Co., George 234
♦Greenlee Bros. & Co. 172
Grotnes Machine Works 224
*Gulf Oil Corp. 208-209

H

Hanson-Whitney Co. 180
Hardinge Brothers, Inc. 5, 46
Heald Machine Co., Subsidiary Cincinnati Milling Machine Co. ..... Inside Front Cover
Hirschmann, Inc., Carl 242
Holcroft & Co. 151
Hy-Pro Tool Co. 20

I

*Ideal Industries, Inc. 191
*Illinite Division, Illinois Tool Works 55
*Ingersoll Milling Machine Co., The, Cutter Division 238

J

Jahn Mfg. Co., The B. 158
*Jarvis Corp., The 167
Jersey Mfg. Co. 224
Jessop Steel Co. 41
*Jones & Lamson Machine Co. 246
Jones Motrola Corp. 236

K

Kaukauna Division, Giddings & Lewis Machine Tool Co. 168-169
♦*Kennametal, Inc. 250
*King Tester Corp. 170
Kingsbury Machine Tool Co. 244
Kuzmick Co., The Paul L. 166

L

Landis Tool Co. 10-11
♦Lapointe Machine Tool Co. 16
♦*Latrobe Steel Co. 255
*Lee Co., K. O. 232
*Leland-Gifford Co. 228
Lempco Industrial, Inc. 165
Lepel High Frequency Laboratories 224
Lincoln Electric Co. 254
Lindberg Engineering Co. 204-205
Link Aviation, Inc. 192
♦Littell Machine Co., F. J. 236
♦*Lodding, Inc. 150
*Logan Engineering Co. 263
*Lovejoy Tool Co. 177
♦*Lufkin Rule Co. 198

M

♦*Madison-Faessler Tool Co. 159
Manhattan Rubber Division,
Raybestos-Manhattan, Inc. 227
Marvel Tool & Machine Co. 214
Master Power Corp., Subsidiary
Black & Decker Mfg. Corp. 188
Mattison Machine Works 229
Meier Brass & Aluminum Corp. 248
*Metallurgical Products Department,
General Electric Co. 29-30-31-32
Meyers Co., W. F. 232
♦*Milford Rivet & Machine Co. 196
Miller Co., The 147
Morse Twist Drill & Machine Co., Subsidiary
Van Norman Industries, Inc. 26-27

N

*National Acme Co., The 233
*Nelco Cutting Tool Division,
Brown & Sharpe Mfg. Co. 193
Norgren Co., C. A. 28
♦Norton Co.,
Abrasive Grinding Wheel Division 13
Machine Division 22-23

O

*Oakite Products, Inc. 155
*Ohio Crankshaft Co., Inc. 74
♦*O. K. Tool Co., Inc., The 253
*Olsen, Tinius, Testing Machine Co. 256
Opto-Metric Tools, Inc. 236
*Ortman-Miller Machine Co. 163

P

♦*Parker-Kalon Corp., Division
General American Transportation Corp. 260
Payne Tool & Engineering Co. 264
Pekay Abrasives, Inc. 166
Perfecto-Peen Division,
Aero-Test Equipment Co., Inc. 199
♦*Perry Equipment & Engineering Co.,
Division Automation Devices, Inc. 176
♦Pipe Machinery Co. 40
Pope Machinery Corp. 9

R

Raybestos-Manhattan, Inc.,
Manhattan Rubber Division 227
Rivett Lathe & Grinder Co., Inc. 68
♦*Robbins, Omer E., Co. 160
Rockford Clutch Division, Borg-Warner Corp. 156
Roto-Finish Corp. 258-259
♦*Russell, Holbrook & Henderson, Inc. 222
*Ryerson, Inc., Jos. T. & Son 76

S

♦*Scherr Co., George 232
*Schrader's Son, A. 247
♦*Scully-Jones & Co. 64-65
♦*Seibert & Sons, Inc. 266
♦*Service Machine Co. 264
*Sheffield Corp., The 67
*Sheldon Machine Co. 252
Shell Chemical Corp. 245
Shell Oil Co. 34-35
*Simonds Abrasive Co. 213
*Simonds Saw & Steel Co. 243
*Simpson Optical Mfg. Co. 153
Sinclair Refining Co. 221
♦*Skinner Chuck Co., The 59-60
Snow Mfg. Co. 58
Sossner Tap & Tool Co. 185
Southwest Products Co. 264
Standard Gage Co., Inc. 54
*Standard Pressed Steel Co. 44
Standard Tool Co. 36
♦*Starrett Co., The L. S. 18
*Stone Machinery Co. 256
Stromberg-Carlson, A Division
General Dynamics Corp. 178
♦*Sun Oil Co. 19
Sundstrand Machine Tool Division,
Sundstrand Corp. 38-39, 182
♦*Sunnen Products Co. 232

T

*Thor Power Tool Co. 262
Threadwell Tap & Die Co. 47
Thriftmaster Products Corp. 235
Timken Roller Bearing Co. 215
*Tinius Olsen Testing Machine Co. 256
Titan Tool Co. 236
Torrington Mfg. Co. 202-203

U

*Union Mfg. Co. 248
Union Twist Drill Co.,
S. W. Card Division 48
Union Division 49
♦U. S. Drill Head Co. 62
♦U. S. Industries, Inc.,
Clearing Machine Corp. ..... Back Cover
♦*U. S. Tool Co., Inc. 33
Universal-Automatic Corp. 261

V

♦V & O Press Division, Emhart Mfg. Co. 146
Van Norman Industries, Inc.,
Morse Twist Drill & Machine Co., Subsidiary 26-27
*Vanadium-Alloys Steel Corp. 57
*Vascoloy-Ramet Mfg. Corp. 144

W

*Wales-Strippit Co. 184
*Warner & Swasey 6
Weldon Roberts Rubber Co.,
Brightboy Industrial Products Division 235
♦*Whistler & Sons, Inc., S. B. 235
Whitman & Barnes, Inc. 61
♦Wiedemann Machine Co. 56
♦Wilson Mechanical Instrument Division,
American Chain & Cable Co. 190
*Woodworth Co., N. A. 211

Y

Yoder Co., The 163

Z

*Zagar, Inc. 197
♦*Zeiss, Inc., Carl 210

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LOOKING AHEAD

By T. W. Black
Senior Associate Editor

Will the Space Age launch an industrial revolution? Yes, says Andrew J. Haley, president of the International Astronautical Federation. His statement: ". . . From the astronautics effort will arise the greatest industrial complex in the history of the world. The combined number of production workers in the automotive field of the entire world and the dollars spent on the automotive industry will . . . be equal to only a fraction of the astronautics industry. During the next 10 years the peoples of the earth will finally be faced with an industrial revolution never before realized. . . ."

The conquest of space is a tool engineering problem. One design for a man-carrying satellite to circle the moon and return to earth calls for a 1000-foot-high booster rocket weighing, with fuel and payload, 125,000 tons. If improved fuels can be used, height of the rocket will be reduced to 600 feet—a structure that will still present quite a challenge to tool engineers. Current American timetables call for a man in orbit around the moon in 1965; a moon base in 1970-75.

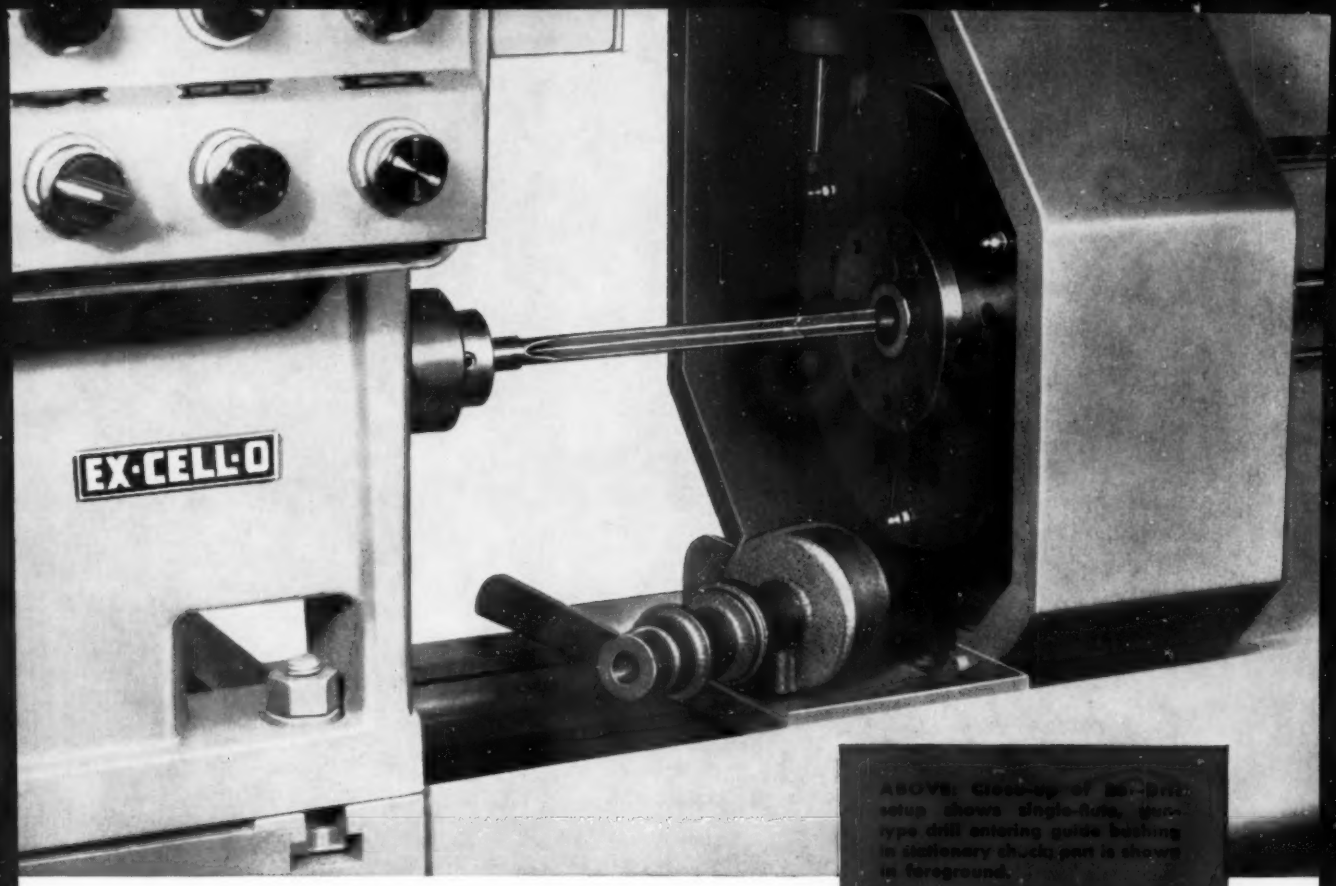
Returning to earth: According to the Value Line Investment Survey, sales of cutting tools are approaching record levels. Machine tool builders are enjoying their highest volume of new orders in two years. For all of 1959, machine tool new orders should reach $550 million, nearly double the 1958 total. A further rise seems likely in 1960.

Approval of a national program to recognize outstanding individual contributions in the fields of engineering and science has been given by the House Committtee on Science and Astronautics. The purpose of the program is to encourage total national effort in engineering and scientific pursuits, to encourage individuals to embark upon engineering and scientific careers, and to focus public attention on national needs in engineering and science.

The program authorized by Committee would take the form of an appropriate medal to be presented annually by the President to not more than 20 individuals who have outstanding records in engineering or scientific achievements. In addition to the medal, each recipient would receive up to $10,000 as a tax-free stipend.

Sound scientific and engineering education is, of course, the primary basis for a rising standard of living. The Soviet Union is now turning out 120,000 engineers yearly. This is about the same number as are graduated in all Western nations combined, including the United States and Canada.

Despite the long-range need for more engineers, freshman engineering enrollment dropped 11 percent in 1958 as compared to 1957, according to a study by the Engineering Manpower Commission of Engineers Joint Council and the American Society for Engineering Education.



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ABOVE: Close-up of Bor-Drill setup shows single-flute, gun-type drill entering guide bushing in stationary chuck; part is shown in foreground.

BELOW: Cutaway of part reveals quality finish of Bor-Drilled hole.

BOTTOM: Equipped for Bor-Drill operation, Style 112-O Precision Boring Machine precision-finishes long hole from the solid in 30 seconds.

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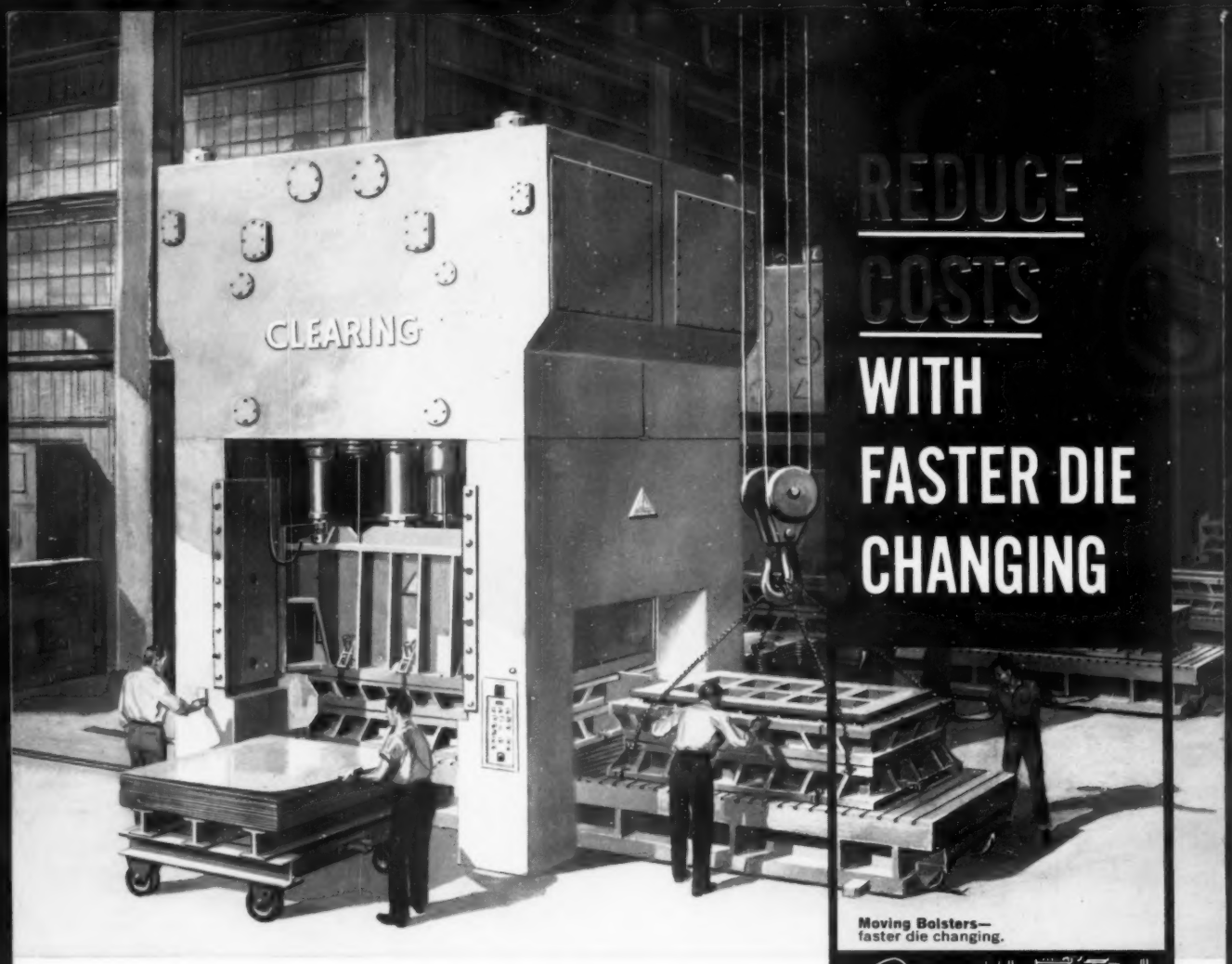

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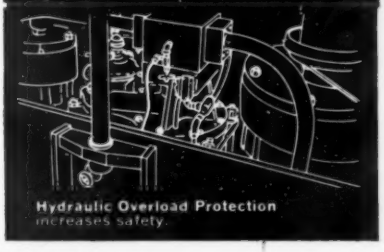

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